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CANADIAN ELECTRICAL ASSOCIATION.

We print elsewhere in this issue a report of the meeting of the Canadian Electrical Association held in Toronto last week, together with abstracts of several of the papers presented. The latter proved of considerable interest to those present, and although important in their scope, were more or less historical in their character. The association showed in its attendance that it has reached a prominent place in the list of such organizations in America, and its influence is now recognized as an important factor in the development of electrical industries in Canada.

THE ACTION OF A CONDENSER.

We were very much surprised some two months ago when reading the statement made by Mr. Mordey in which he maintained that the effect of a condenser when subjected to periodically varying differences of potential was to produce a large lagging current rather than one having a small angle of advance. We have been still more surprised at the persistency with which he maintains this assertion. Had this idea been suggested by any one less prominent in the profession the probabilities are that it would have met with considerably less respect. Mr. Mordey is apparently unwilling to accept the results of mathematical demonstration, hitherto considered in this case one of the simplest in alternating-current theory, maintaining that to think of the current as leading is equivalent to asserting that the cause precedes the effect. No more, however, is this so than in the simple fact that water seeks a lower level. As pointed out by Mr. Kelly, if the lag were always 270 degrees or the lead 90 degrees the question would perhaps be indeterminate, but inasmuch as the angle may vary over a wide range, depending upon the circuit conditions, it would, were we to consider the current as lagging, have a minimum value for a maximum capacity effect, and as the E. M. F. due to the condenser diminished relatively to that of the resistance, the angle would become greater, until with resistance only remaining, there would exist the absurd condition that the current lagged 360 degrees. It is not likely, however, that at this late day any explanation will convince Mr. Mordey of the fallacy in the opinion he so tenaciously maintains.

THE ELECTRICAL RELAY PRINCIPLE IN GOVERNORS.

Of the various electrical devices which have been suggested for automatically governing an engine or water-wheel, the principle of the electrical relay offers distinct advantages. It is universally recognized that the duty of a centrifugal governor should be as light as possible in order that it may be actuated only by the forces attendant upon the change of speed and not hampered or damped by the retarding influences of the duty it has to perform. Not the least of the many improvements introduced in the Corliss detatching valve gear was the much lighter duty imposed upon the governor. The principle of an electrical relay realizes this principle in the greatest possible degree. The opening and closing of an electrical circuit theoretically requires no energy, and practically but very little. The governing action may therefore be made extremely delicate, the controlling parts being made in the best possible manner and so enclosed as to offer of ready inspection on the part of those in attendance. The electrical impulses may be transmitted to any desired locality to actuate the necessary governing mechanism. This advantage is of particular importance in the control of water-wheel governors where of necessity the mov-

ing parts must be placed in positions more or less detrimental to good machinery. When constant speed is desired the relay may be controlled by a centrifugal governor, and for constant voltage a magnet could be energized from the bus-bars so as to vary the speed slightly. For controlling arc machines it would be necessary simply to use a series-magnet to actuate the relay. The speed could then be made to vary from that just sufficient to make the magnet operative to that corresponding to full load. The governor could be made to control from several sources, any one of which could be used at pleasure.

A NEW TELEPHONE COMPANY.

The prevailing quiet in electrical circles was broken during the past week by the announcement of the incorporation at Albany of the New York Telephone Company. This bit of news, which was conveyed to the public through the usual channels, was not dissimilar to other like items that are frequently found in the public press, but when the names of the incorporators were read, very great interest in the project was at once aroused. The mention in this connection of the names of prominent Western Union Telegraph officials and of other persons equally prominent in the councils of the Bell Telephone Company very naturally excited intense curiosity in electrical circles as to what would be the relations of the new company to the one already existing. In seeking for an answer, in the absence of authoritative information, the explanation that first suggested itself to those most interested was that a powerful rival of the Bell Telephone Company was embodied in this new concern. This explanation, however, was difficult to harmonize with the fact that prominent officials of the Bell Company were named among the incorporators of the new. A meeting for the purpose of affecting organization will be held this week, and it is stated that the public may afterward learn something definite of the plans. In view of the fact that the famous agreement between the Bell Telephone Company and the Western Union Telegraph Company will expire on Nov. 10 next, the creation of the new company at this time is very significant and undoubtedly has a very important bearing on this compact. Mr. George J. Gould, who is one of its incorporators, states that it was not organized in opposition to the American Bell Telephone Company. It seems to be the belief, in some quarters, that the new company will absorb the Metropolitan and New York & New Jersey telephone companies and extend the two systems. It will, it is suggested, be under the control of the Western Union Company, working under a license from the Bell Company. On the other hand, it is thought by some that the Bell Company has the controlling interest. The details of its organization will be found on another page in this issue, and further information is awaited with deep interest.

WAVE-FORMS OF APPLIED POTENTIAL DIFFERENCE.

There is printed elsewhere in this issue the final installment of the Institution paper on "Experimental Tests on the Influence of the Shape of Applied Potential-Difference Waves on the Iron Losses of Transformers," by Messrs. Beeton, Taylor and Barr. The conclusions which it contains are important from a theoretical as well as practical standpoint. Since the somewhat animated discussion of the relative values of distorted and sine waves of impressed E. M. F. as applied to transformers, arc lamps, synchronous and induction motors, considerable work has been done accompanied by an equivalent amount of progress. Not the least part in the advancement has been the improved mathematical treatment of the alternate-current transformer, bringing the analysis more in harmony with experiments rather than basing experiments and deductions on irrelevant theory One of the most important contributions to the subject of distorted waves of E. M. F. is contained in a paper read before the *Verband Deutscher Electrotechniker*, July 6, 1895, by Dr. Rössler, a paper which contains the principal conclusions arrived at in the one presented before the Institution of Electrical Engineers. Dr. Rössler found that peaked curves of applied potential difference gave a better efficiency than the rounded form, but that the secondary potential regulation was better when the latter were employed. He also showed that the hysteretic losses depend upon the ratio of the true mean value of the applied difference of potential to its effective value, the reciprocal of which ratio has been designated by Prof. Fleming as the form factor. Inasmuch as the eddy current loss is not affected by the form factor, it follows that if this factor has a constant value, the form of the applied potential difference curve may vary through wide limits, without affecting the total core loss. It is doubtless owing to slight differences in form factors that many investigators have failed to detect any discrepancy between peaked and rounded waves in static transformers. The present paper is most interesting on account of the method adopted of altering the form of the applied potential-difference wave by injecting at definite intervals a capacity or resistance. Some conclusions expressed in the paper, however, seem to have but little bearing on the experiments, as, for instance, that the eddy current loss is proportional to the square of applied potential difference, a conclusion which could as well be predicted as formed from the results expressed in the table as a basis, thus making the statement that with a constant effective value of the applied potential difference the eddy current loss does not depend upon the wave-form, quite independent of the experimental results. As to the effect of higher harmonics having various phase relations with the fundamental, it is true that the resultants may have the same effective value and yet have areas differing by several per cent. It is doubtful, however, whether the case of depressed waves deserves more than a theoretical consideration, inasmuch as such curves are not likely to be produced in self-inductive circuits without capacity. If the latter be present, we believe it remains undisputed that condensers work most effectively when supplied with either rounded or sine waves of applied potential difference. The higher efficiency obtained by the peaked form has been plausibly explained by Dr. Bell, by stating that the effect of superimposing upper harmonics is equivalent to increasing the frequency. Variable conditions of load may produce sufficient differences in the shape of the E.M.F. waves to make it practically impossible to predetermine the most effective form of wave which an alternator should produce. It is for this reason that the laboratory results obtained have a limited value when their application in commercial practice is considered. Of the several important factors favoring the use of rounded or sine waves may be mentioned the following: They produce the least inductive drop on the line; they present a standard form which from the synchronous-motor standpoint, and perhaps from that of arc-lighting, is an invaluable property. Resonance phenomena are reduced to a minimum, and at the same time such waves do not so severely test the insulation. On the other hand, peaked waves produce a less hysteretic loss thereby increasing the efficiency anywhere from a fraction of 1 per cent. to 10 per cent. This has a most important bearing on the all-day efficiency of transformers. This increase, however, may in some cases be overbalanced by increased eddy loss. Another important point is that the power factor becomes considerably greater where transformers are used. As to the overbalancing merits of the two types of waves, only specific cases can decide. The advantages which might be gained by the use of peaked waves in ordinary commercial alternating-current supply, although considerable, are of doubtful attainment. We are still forced to the opinion that no great efforts will be made on the part of manufacturers to determine the best form of peaked E. M. F. which an alternator should have in order that it may apply more satisfactorily than the existing types to the conditions presented in widely differing cases.

A New Telephone Company.

Deep interest was excited in telephone and telegraph circles last week by the news of the incorporation in Albany of a new telephone company of large proportions, and speculation was rife as to what part the new company proposed to play in the telephone field.

The name of the new concern is the New York Telephone Company, and its capital is $16,000,000. The object of the company as set forth by the incorporation papers is to construct, buy, or lease lines of electric telegraph and telephone to be operated in New York City, and thence to Albany and Boston and the immediate cities, towns, and places in New York, Massachusetts, Rhode Island and Connecticut; also across or under the North and East Rivers and New York Harbor to Jersey City, Long Island City, Brooklyn and Port Richmond, S. I.; also through New Jersey to Philadelphia, and to the intermediate cities and towns; also from Long Island City and Brooklyn to Montauk Point, L. I., and to the intermediate cities and towns; also from Port Richmond, S. I., to all places in Staten Island, and also to other cities, towns and places in the States mentioned, and to connect with the other lines leading to places outside of the territory.

The incorporators are: Charles F. Cutler, of Morris, N. J.; John H. Cahill, Joseph P. Davis, Thomas T. Eckert, William T. Bouchelle, James Merrihew, and William H. Wolverton, of New York City; William H. Forbes, John E. Hudson, of Boston; George J. Gould, of Lakewood, N. J.; John Jameson and Charles A. Tinker, of Brooklyn, and John Van Horne, of Bayonne, N. J. The capital stock is divided into 160,000 shares, and each of the incorporators subscribes for 10 shares. The company paid the State a tax of $20,000 for the privilege of incorporation.

The directors of the new company named in the articles of incorporation represent the following companies: Western Union Telegraph Company, George J. Gould, Thomas T. Eckert, Charles A. Tinker, James Merrihew, and John Van Horne; American Bell Telephone Company, John E. Hudson, and William H. Forbes; Metropolitan Telephone Company, Charles F. Cutler, John H. Cahill, Joseph P. Davis, William T. Bouchelle, William H. Wolverton, and John Jameson.

The fact that the existing contracts between the Western Union Telegraph Company and the American Bell Telephone Company will expire in November next caused the impression that the incorporation of the New York Telephone Company meant that the Western Union Telegraph Company intended to enter the field as a rival of the Bell Telephone Company. This, however, was said by George Gould to be untrue. As to the real purpose of the company, however, nothing could be learned from any of the gentlemen interested who were seen.

A meeting for organization is to be held during the present week after which a public announcement is promised.

It is stated that Western Union men predominate in the new corporation, and that they hold the controlling interest.

The Hon. Garret A. Hobart an Electrical Man.

Our Republican friends may find grounds for felicitation in the fact that the Hon. Garret A. Hobart, who is the Republican nominee for Vice-President of the United States, is prominently identified with electrical interests in his State—New Jersey. He is president of the Paterson Railway Company, Paterson, N. J., and a director of the Edison Electric Illuminating Company, of Paterson. Besides these he is closely connected with many other large industrial, commercial and transportation enterprises.

When the news of Mr. Hobart's nomination was received at his home on the night of June 18, eight cars, profusely illuminated and decorated with bunting, were run over the lines of the Paterson Electric Railway to celebrate the event. The jubilant Patersonians who occupied the cars had supplied themselves with plenty of firecrackers, and while the trip was being made pandemonium reigned.

Standard Wiring Rules.

The conference on standard electrical rules, which met in New York on March 18 and 19, will not hold a meeting in June, as was contemplated at the first meeting. As the Committee on Rules have not yet completed their report the meeting has been deferred until a later date, probably in the Autumn, of which due announcement will be made when the time has been decided upon.

English Fraternalism.

In commenting upon the recent experiments of Profs. Dewar and Fleming on the effects produced by low temperatures on the electrical conductivity of metals and the magnetic properties of iron, the London *Electrician* makes a statement which shows the characteristic English spirit. "England has now a long lead in the matter of low temperature research, and we trust that both the men and the money will be forth coming to enable this lead to be maintained. Science, it is true, knows no geographical boundaries, but many of those who devote their lives to scientific research still retain a remnant of an ancient superstition known as patriotism, and would like in this matter to see England first—and the rest nowhere." We can hardly blame our worthy contemporary devoted to the interests of scientific investigations for still another trusting hope that the fruits of this field may not follow the course of history and in turn be grasped by a foreigner. American spirit is, however, too warm to allow of research in such a chilly atmosphere, and in all probability the field will for some time be left to its present highly esteemed occupants, unmolested in their search for new scientific truths.

Convention of Railway Telegraph Superintendents.

The fifteenth convention of the Association of Railway Telegraph Superintendents was held at the Hygeia Hotel, Old Point Comfort, Va., on June 17, 18 and 19. There was a large attendance, and several steamboat and trolley excursions and a trip to Richmond constituted the features of entertainment.

Some good papers were read. Mr. H. C. Hope, of St. Paul, Minn., presented one on "Electric Light and Power," also one on "Telegraph Line Construction and Reconstruction," and U. J. Fry, of Milwaukee, Wis., read one on "Reduction of Relay Resistance."

The election of officers for the ensuing year resulted as follows: President, George M. Dugan, Chicago; vice-president, J. W. Lattig, South Bethlehem, Pa.; secretary and treasurer, P. W. Drew, Milwaukee, Wis.

Niagara Falls, June 16, 1897, were selected as the place and time for the next meeting.

There were a few exhibits. Mr. W. S. Logue showed the Edison phonoplex in actual operation between the hotel and Richmond.

The Best Telephone Manufacturing Company, Baltimore, Md., exhibited samples of its telephones, which transmitted and reproduced the voice and other sounds in a very loud and distinct manner.

The Municipal Electrical Association.

The Municipal Electrical Association has recently been organized in England, the first convention being held on June 10, 11, and 12 at the Royal United Service Institution, Whitehall. It was owing to the great number of municipalities in Great Britain operating central stations and the great success of American conventions of similar import that interest was aroused in forming an organized representative body. Mr. Wright is the first president. The success of the undertaking is largely due to Mr. William L. Magden, honorary secretary.

The principal papers presented were: "Electricity Supplied at 220 Volts," by A. S. Barnard; "Alternating-Current Stations and High-Voltage Lamps," by H. W. Couzens; "The Control by Municipal Authorities of Consuming Devices," by C. H. Wardingham, and "Electricity Works Records," by A. B. Mountain.

Bullets Swerved by Electrical Currents.

The *Journal de Génève* is authority for the statement that at some recent trials of the Swiss Federal Rifle meeting in practice shooting, curious deviations were noted in the results of the shots, the cause being finally attributed to the electrical conductors paralleling the range. In order to corroborate this supposition the authorities established parallel with the range and at a distance of about 120 feet, four steel cables carrying heavy currents. It was found that for a range of 260 yards the bullet was laterally deviated about 70 feet. Beyond this range the deviation became still more apparent, and when using artillery and a range of 3000 yards the deviation amounted to 14 degrees.

It would be difficult to prophesy the final bearing which these experiments may produce in the art of future warfare.

An Apparatus for Determining Induction and Hysteresis Curves.

BY FRANK HOLDEN.

The description in *The Electrician*, of May 8, 1896, of an instrument lately exhibited by Prof. Ewing before the Royal Society, reminds the writer of a very similar instrument built by himself over a year ago.

The essentially novel features of the electromagnetic arrangement were perhaps first described by the writer in The Electrical World of Dec. 15, 1894, although he had used it in the early part of that year for measuring permeability.

The apparatus, as finally constructed, is shown in Fig. 1 and also diagrammatically in Fig. 2, the corresponding parts having the same relative positions. The connections for current were made by means of the two right-hand binding posts, from which wires led directly to the reversing switch A, which reversed the current throughout the instrument. The switches B and C reversed the current in the magnetizing coils b and c, respectively. R was a resistance through which the current of the coil b passed, and R_1 was an equal resistance carrying the current of the coil c. S was a variable sliding resistance shunting the coil b, and the resistance R, and S_1 was a similar resistance shunting the coil c, and the resistance R_1. These two variable resistances were operated by rotating the two knobs shown in Fig. 1. By means of this arrangement of resistances and an exterior rheostat, the currents of the two coils b and c could be varied independently in so far as was necessary. The switch D enabled the two left-hand binding posts to be connected to the ends of either the resistance R or R_1, as desired. To these binding posts was connected a low-reading Weston voltmeter, which was of sufficiently high resistance to cause only a negligible variation in the current of the coils b and c when the connections were changed in any way.

Under these circumstances the deflection of the voltmeter was proportional to the current passing through the resistance across which it might be connected by means of the switch D, which current equaled that in the magnetizing coil immediately in series with the resistance. Therefore it was simply a matter of adjusting the resistance of the voltmeter and properly marking the scale to enable the magnetomotive force in either coil to be read directly from the voltmeter when a balance had been established in the magnetic arrangement. The voltmeter had two circuits of different resistances so that when one circuit was used a deflection across the scale corresponded to $H = 10$ and when the other circuit was used the same deflection corresponded to $H = 100$, which was the maximum M. M. F. which this particular instrument was constructed to indicate.

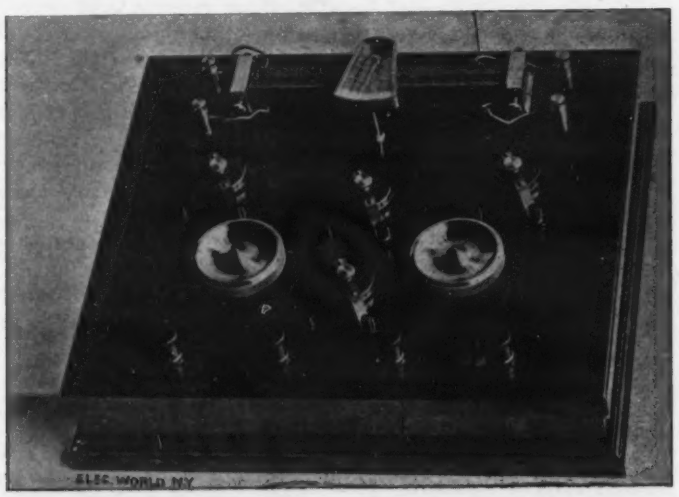


Fig. 1.

The absence of any external field from the two bars was shown by a simple and not very sensitive magnetometer placed midway over the bars; it being quite unnecessary to concentrate the field for the magnetometer by means of the additional iron pieces Prof. Ewing uses, and which would apparently cause some trouble if the apparatus were to be used for hysteresis measurements. It was found that with this apparatus two bars could be compared as to permeability with greater accuracy than the absolute measurements could be made. The bars for test were made to fit easily into the holes in the two blocks at their ends, no trouble being taken to get a very close fit as the results were quite identical with great variations in the character of the fit.

For sheet iron testing the blocks were constructed to clamp the bundles of strips used, and as before there was no evidence of any appreciable reluctance at the joints. Fig. 1 shows the instrument as it was used for testing sheet iron, but for testing solid bars the only change necessary was to substitute for the magnetizing coils those shown in Fig. 3, using of course a suitable standard bar.

The magnetometer needle having been brought to zero by means of a controlling magnet, the necessary standard might be put in its

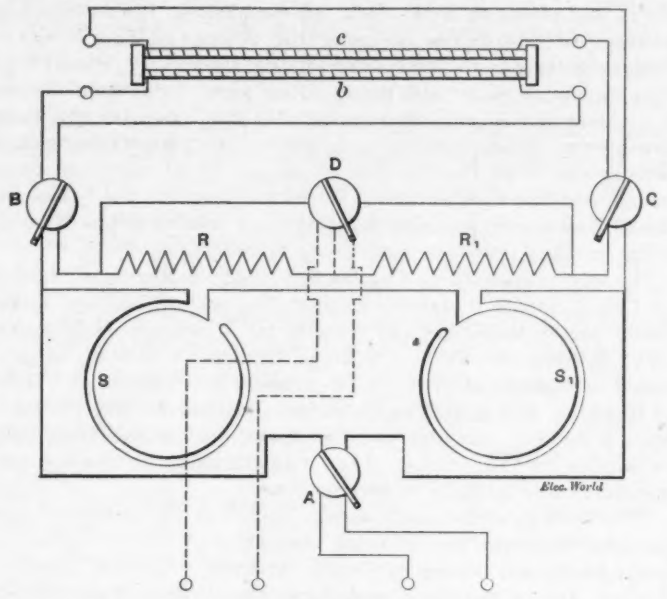


Fig. 2.

coil and then, in deriving the induction curve, the process was as follows:

The standard is supposed to have been in the coil C. If the measurement was to be made at a certain induction value, the magnetomotive force necessary for the standard having been found by reference to the known induction curve of the standard, the current was adjusted until this M. M. F. was produced as shown by the voltmeter. Then, by alternately reversing the current, a condition was reached in which a reversal of the current produced no permanent change in the position of the magnetometer needle. The induction was then obviously the same in the two bars, and the M. M. Fs. were shown by the voltmeter. This determines one point in the desired curve, other observations obviously being made by using different values of magnetizing currents. The values of B in the two portions of the magnetic circuit were inversely as their cross-sections and allowance had in general to be made for this in testing sheet iron because of the variations in its thickness.

In describing the method of getting the hysteresis curve it will be assumed that the cross-sections of the standard and the test piece were equal.

By referring to the hysteresis curve of the standard it was found what M. M. F. was necessary to produce the maximum induction; about 7000 being used as most convenient.

Having the proper current in the coil of the standard then, as in the permeability test, a balance being established, the induction in

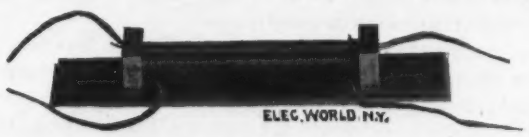


Fig. 3.

the test piece was equal to that of the standard which was known and the M. M. F. was shown by the voltmeter which determined the extreme points of the desired curve. By altering the resistances S and S_1 together, so that the balance was little disturbed, the M. M. F. in the standard was reduced to any desired degree, and then by getting a quite accurate balance, care being taken always to change in the direction of the other extreme of the curve, the corresponding M. M. F. in the test piece was read from the voltmeter. The induction in the standard was found by reference to its curve already known, thereby giving the induction in the test piece. This deter-

mined another point in the curve, and any others were found by a continuation of the process. In general, the current in one of the coils *b* or *c* had to be reversed before the other, for which purpose the switches *B* and *C* were used. The curves shown in Fig. 4 show the accuracy obtainable with ordinary care. The full line is the result of the usual ballastic test, and the dotted line the mean of four

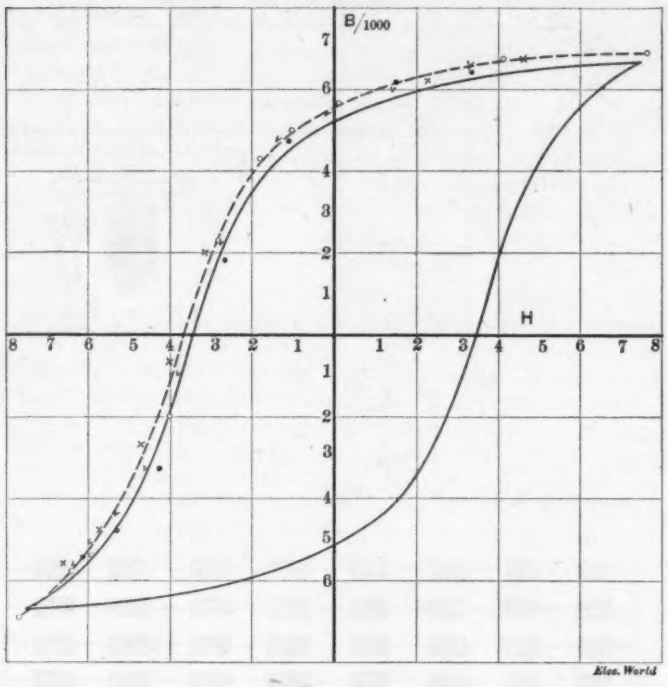


FIG. 4.

tests with this apparatus, points for each series of observations being shown by different characters. Part of the apparent discrepancy between the curves is obviously due to the ballastic test having a smaller maximum induction.

The Storage Battery in Telegraph Work—III.

BY MAURICE BARNETT.

(*Continued from page 743.*)

Passing on now to the consideration of special installations of storage batteries in telegraph offices, and dealing first with local circuit work—it is clear that, as stated, the cheapest and simplest arrangement of a storage battery is one in which the battery is kept continuously charged while circuits are being worked off it. It was, as a matter of fact, in such a connection that storage batteries were first used for telegraph work. About three years ago the Western Union Telegraph Company installed in the Cortlandt Street office, New York, a single storage cell, which was kept charged by a current sent through a wire from the main office. This cell was used to operate 12 local circuits and performed work which had previously required the use of 30 primary cells.

This arrangement is open to the objection that the reserve capacity is very small. In practice it is customary to use two sets of cells. Fig. 7 shows this duplicate arrangement. The drawing represents the battery *B* in series with the lamps while charging is proceeding —the battery *B'* being used on the local instruments. By "throwing" the switches the positions of the batteries will be reversed—*B'* being put in the charging circuit and *B* on the locals. This represents the local storage-battery arrangement in the Brooklyn main office of the Western Union Telegraph Company.

An interesting application of storage batteries for local circuit work is the one connected with the operation of important "loop" offices. According to Mr. Finn, these branch offices are placed in communication with distant points "by including the said offices in the local circuits of the transmitting and receiving duplex and quadruplex apparatus located in the main office." By moving the controlling switches one way, the main office is alone put in circuit; but when the switches are turned the other way the branch offices are included in the circuit. Now, these branch offices are operated from the main office by means of a small dynamo. If there were no battery in series with the instruments of the branch office the current from the dynamo would go to waste through the ground wire. But by arranging a storage battery in series with these instruments the current passes through the battery before being "grounded." The storage battery, charged thus, may be used to operate other local apparatus connected with this branch office—a work previously requiring many primary battery cells.

In order to equalize the current in these loop offices and overcome the loss in pressure incidental to inserting a cell that would, by its counter E. M. F., diminish the pressure of the main current, the resistance of the circuits will have to bear a certain relation to the E. M. F. of the current. A convenient method of altering the resistance of such circuits is by means of lamps of different voltage, these being substituted one for another according to requirements. This method of applying "compensating lamp resistance" was worked out by Mr. Athearn, one of the engineers of the Western Union Telegraph Company.

Another application of storage batteries to local circuit work is that found in the Atlanta office of the same company. By reference to Fig. 8 it is seen that there are two sets of batteries—three cells to a set—of which one is in use on the circuits, while the other is held as a reserve in charging. The characteristic feature of this installation is the fact that the current used to charge the battery is taken from a 1-hp motor-generator, which is run as a motor from a 500-volt circuit, and delivers current at 16 volts. The charging circuit is provided with an automatic cut-out to prevent the battery from discharging in case the generator slows down. The cells, moreover, are all charged and discharged in series. On the discharge the cells are connected on the three-wire system.

The three-wire system of battery arrangement is very largely used in telegraphic work, not only on account of the economy it makes possible in the use of cables, but because of the ease by which the E. M. F. of any circuit may be doubled when such procedure becomes necessary. This use of the three-wire arrangement in local circuit work is especially desirable; for the transmission of currents of considerable density at a pressure of two or four volts requires large conductors if loss is to be avoided in wires that extend to a considerable distance from the main office. As a case in point, at Hartford, there are 52 local circuits taking, in the aggregate, between 15 and 16 amperes. This current is conveyed from all the local circuits through three conducting mains. Advantage is also taken, in this installation, of the possibility of doubling the E. M. F. in those circuits where there is a combination, in a single circuit, of both sounder and transmitter.

Of the more pretentious installations, and especially those used for long-distance work, may be mentioned that in the Atlanta, Ga.,

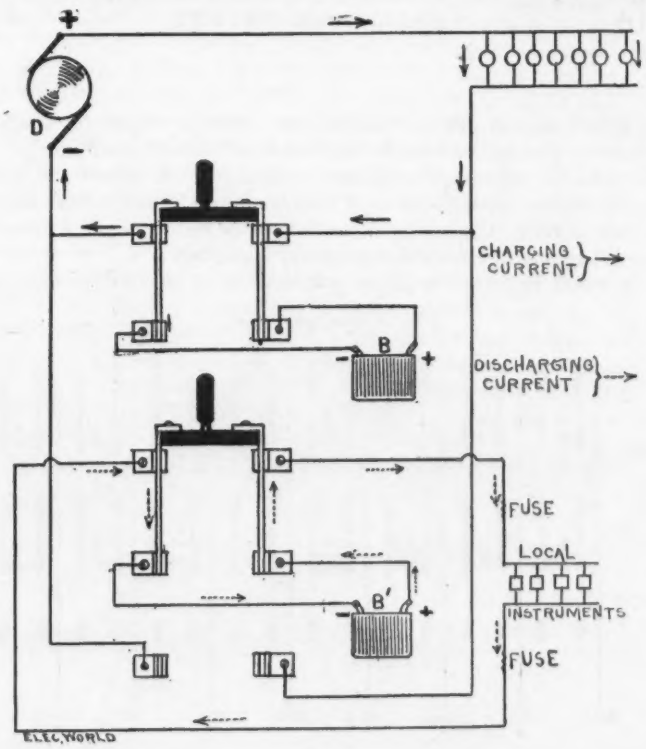


FIG. 7.

office of the Western Union Company, where 688 "chloride" cells are performing the work previously requiring 8000 gravity cells. The installation includes 344 cells of 75 ampere-hour capacity, 172 cells of 50 ampere-hour capacity, and 172 cells of 25 ampere-hour capacity. The main battery consist of two sets of cells, of which

one is in use on the circuits, while the other is being charged. Each is divided into eight groups of 43 cells, which are charged in multiple series and discharged in simple series. This arrangement will be made clear by reference to Fig. 9, of which the upper part shows the charging and the lower the discharging circuits. The drawing indicates clearly that the battery is so tapped, during discharge, as to yield four different potentials on four independent circuits, 86, 172, 258 and 344 volts. It is noticeable, moreover, that some of these

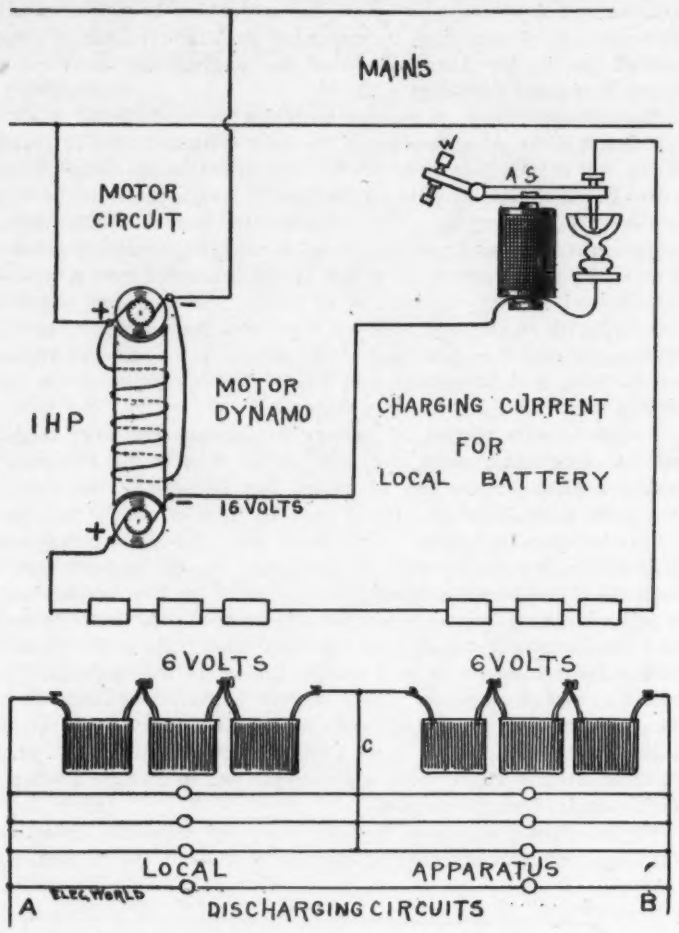


Fig. 8.

cells have larger capacity than others. This is made necessary by the fact that more current is taken on some circuits than others. In charging the cells it is easy to give each size of cell its normal charge by regulating the resistances of the charging circuits. The characteristic feature, as already explained, is the reduction of a 500-volt current to one of 110 volts suitable for charging.

Of equal importance is the installation of accumulators in the

As can be seen from Fig. 10, the main battery consists of 640 cells arranged in 16 groups of 40 cells each and marked 1 to 16 inclusive. These cells are charged in multiple series and discharged in simple series. With the switches arranged, as shown in the diagram, bat-

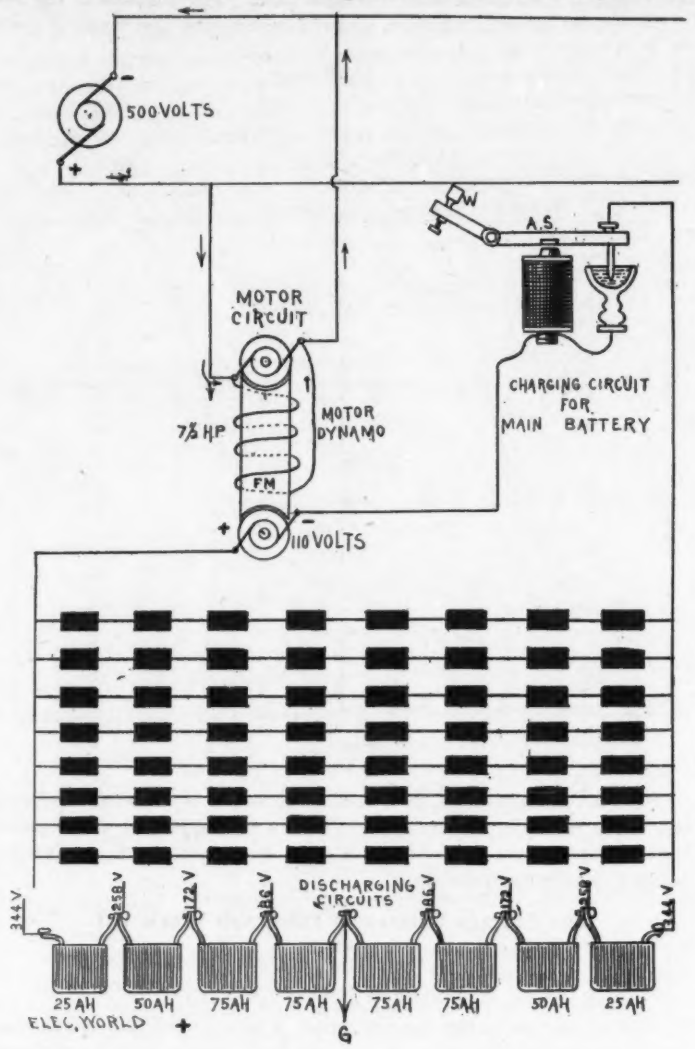


Fig. 9.

teries 1 to 8 are being charged from a 110-volt circuit while batteries 9 to 16 are being used on the working circuits which are variously supplied with current at a potential of 80, 160, 240 and 320 volts. Batteries 1, 2, 7, 8, 9, 10, 15 and 16 are of 12½-ampere-hour capacity, while 3, 4, 5, 6, 11, 12, 13 and 14 are of 50-ampere-hour capacity. The short wire battery differs from the main battery in being charged in series and discharged in multiple. This battery consists of 78 cells of 50-

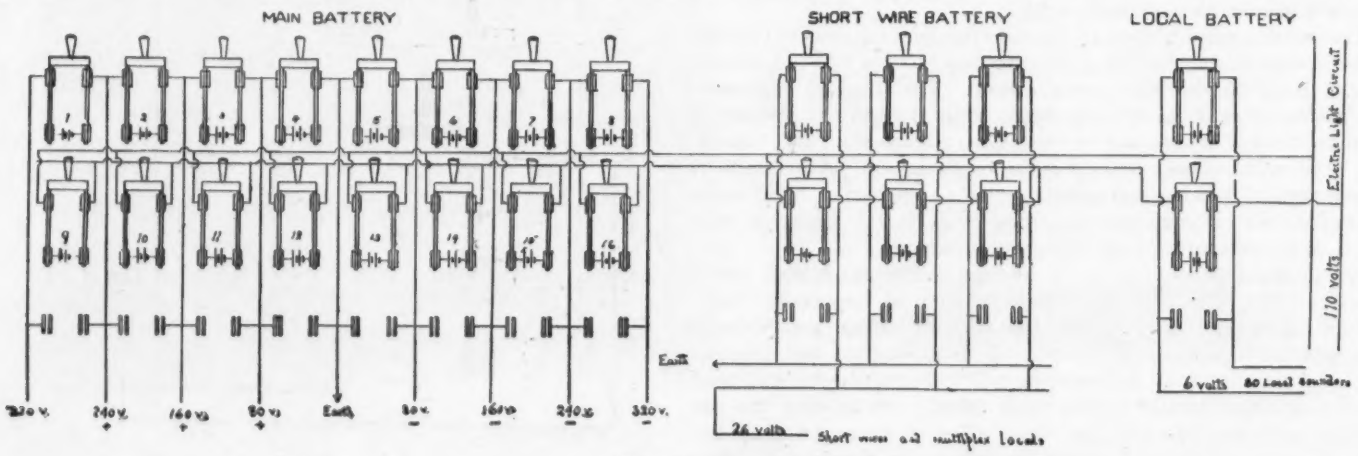


Fig. 10.

Washington office of the Western Union Telegraph Company. This plant consists of 724 "chloride" cells made up of 398 fifty-ampere-hour cells, 320 12½-ampere-hour cells and 6 cells of 125 ampere-hours capacity for local circuit work. These cells are doing the work which formerly required the use of 7300 gravity cells.

ampere-power capacity. In this station no transforming machinery is used.

An installation not dissimilar to the foregoing, although much smaller in size, was installed last Summer at West End, Long Branch, N. J., to handle the Summer business, which was expected

to be large. Fig. 11 represents the grouping of the batteries. As can be seen, these are divided into seven groups of 28 cells each. They are charged in multiple—an arc light circuit constituting the charging current. Two hours charging daily at the rate of 1½ amperes per battery is sufficient to keep the batteries charged. The batteries *A'* and *B'* are charged alternately every other night. Four hundred and fifty gravity cells were displaced by these accumulators.

In addition the foregoing important storage-battery plants have been installed in Western Union offices at Easton, Pa., Bridgeport, Conn., New York City and Mauch Chunk, Pa.; for the Postal Telegraph Cable Company at Albuquerque, N. M., and at Baltimore, Md. For fire-alarm and police-telegraph purposes storage-battery installations of considerable magnitude have been made at Hartford, Conn., Jersey City, N. J., Rochester, N. Y., and Springfield, Mass.

There are, of course, many offices, especially small ones, where no charging current is at hand and where it would seem necessary to use a primary battery. The question, however, has been raised whether it would not be cheaper to collect storage cells from time to time, and send these to some charging station for renewal—using, in the mean time, duplicate storage cells on the circuits. The expense of handling would offset the economy of using storage batteries, but on the other hand the service would be more satisfactory. This question is now being seriously considered by telegraph and telephone companies—with the chances that the storage battery will ultimately be adopted even in those isolated cases where only two primary cells are now used. As bearing on this, Mr. MacRae mentions, in an article contributed some time ago to the *Electrical Engineer*,

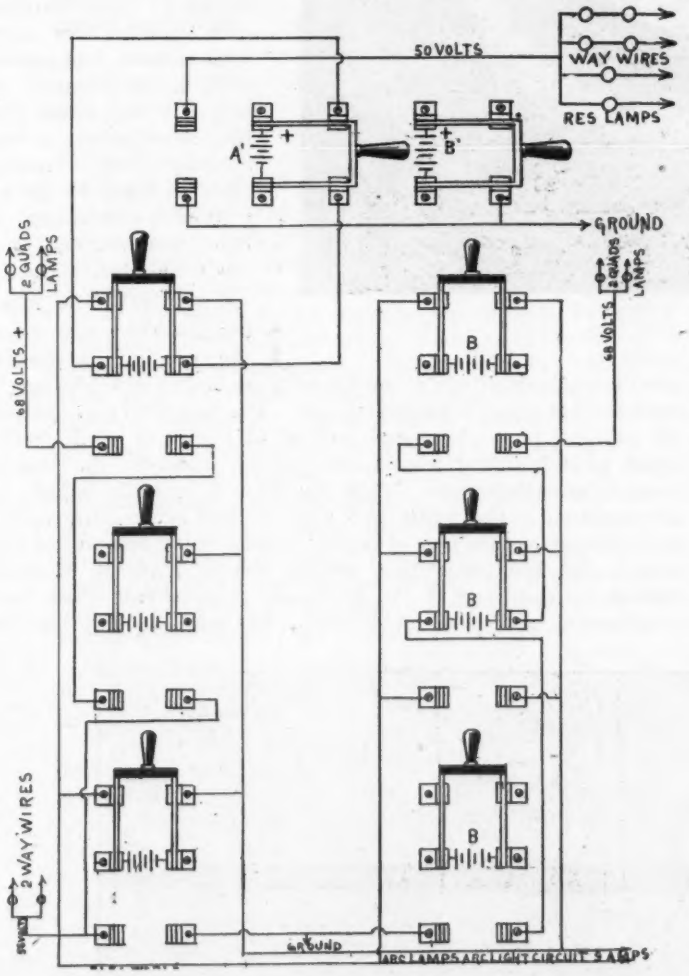


FIG. 11.

that in the Baltimore office of the Chesapeake & Potomac Telephone Company two portable storage batteries were used. When one became exhausted two men carried it three squares to the nearest charging station—its substitute in the meantime being put on the circuits. One of these portable batteries replaced 80 gravity cells. Although the handling of the storage battery was awkward, the Chesapeake & Potomac Telephone Company found the secondary battery so much superior in service to the primary battery that the change was considered a beneficial one.

Experiments with the Polarizing Photo-Chronograph to Determine the Motion of Projectiles Inside the Bore of a Gun.

BY ALBERT C. CREHORE AND GEORGE O. SQUIER.

In THE ELECTRICAL WORLD of Aug. 10, 1895, were described some preliminary experiments with the Polarizing Photo-Chronograph applied to the measurement of the velocity of projectiles outside the bore of a United States 3″.2 breech-loading field rifle. The results of these experiments being submitted to the Board of Ordnance and Fortification, a chronograph built upon this principle, making use of polarized light, was authorized, and the construction of the same entrusted to our care.

Since the original experiments were more of the nature of a laboratory investigation than suited to the practical needs of the military service, it became our first purpose to perfect the details of the instrument by further experimentation, in order to avoid hastily assembling for the Government an instrument which, when completed, would manifestly be capable of great improvements. Accordingly, the experiments to be described below were carried out at the United States Artillery School during the month of August, 1895, and the official report of which is to be found in the *Journal of the United States Artillery*, May-June, 1896.

The immediate objects of these experiments were two-fold. First, to perfect a practical chronograph upon this principle, suited to the needs of the military service, and second, to determine the adaptability of this instrument to the study of the motion of projectiles inside the bore of a gun.

There was, at the outset, no reason to doubt that this chronograph could be employed as Noble's or Schultz's chronoscopes formerly have been, to determine interior velocities in cases where the gun might be mutilated by piercing holes along the bore at intervals, and inserting electric circuits to be interrupted by the projectile as it passes. Yet the usefulness of such a method is so insignificant, compared with any plan which would enable interior velocities to be measured at any time, and in any gun, with almost as great ease as exterior velocities may now be obtained, that it became our purpose to search for such a method. Although the time as yet available for this work has been very limited, and the constant pressure of other duties prevented anything but a superficial examination of results, yet it is thought that sufficient success has been attained to warrant this early presentation of an account of the experiments thus far conducted. The observations themselves which are presented we deem of secondary importance compared with the method outlined, since they may easily be confirmed or disproved by future trials.

Two general physical methods have been employed in experimentally determining the pressures developed in the bore of a gun, viz., the statical and the dynamical method. In the former class come the early experiments of Count Rumford, 1792; Gen. Rodman's cutter gauge, and that of Col. Uchatius, and Noble's crusher apparatus. In each of these the force which holds in equilibrium the force of the powder gas is the observation recorded and measured. The dynamical method of experimenting consists in investigating the motion of some body connected with the gun system so as to be under the influence of the expansive force of the powder gas, and from the circumstances of this motion, to pass by calculation from known laws of dynamics to the pressures required to produce such motion.

In all the dynamical methods, besides being dependent in each case upon certain arbitrary assumptions as to the nature of the action of the gases upon the piston or other body as compared with its

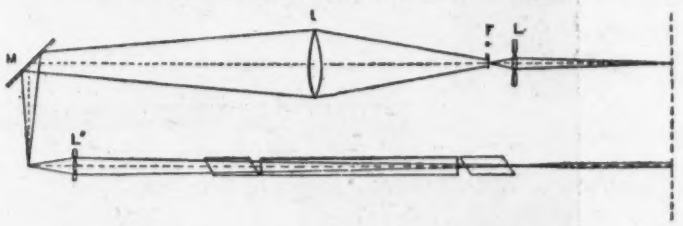


FIG. 1.

action upon the base of the projectile itself, they are open to the general physical objection that the desired data are derived and not directly observed.

In other words a fundamental rule of physical investigation requires the experimenter to direct his energy upon the study of the thing itself when possible in preference to observing other phenomena connected thereto and obtaining the desired result by processes of derivation. This fact of itself especially commends all dynamical methods which are directed to the observation of the law of motion

of the projectile in preference to any auxiliary body, for we may be sure that the more complete our knowledge of the motion of a projectile during its passage through the bore, the more nearly can we approximate to the true law of change of pressure upon its base and the walls of the chase adjacent thereto.

Various attempts* have been made by the French Marine Artillery to record the passage of a projectile through the bore without mutilating the gun. In 1876 a method was tried in which a wooden rod of sufficient length to extend beyond the muzzle was attached to the projectile. On its extremity was fixed normally a sheet iron disc which, in the movement of the projectile, encountered successively interrupters placed on a strong wooden rule parallel to the axis of the gun, in front of the muzzle, and fastened to the chase of the piece by strong iron collars. The distances were measured along the rule and the times by a chronograph. This arrangement, which might answer for a gun of small length and a low velocity, failed with high velocity and a rifled gun. A better method has been found in the employment of interrupters glued in the bore, proposed by Mr. Letard. These interrupters, which may be placed in the bore to the number of five or six, are secured one after another by means of common resin. They are set in position by an expansion rammer with a movable wedge similar to those used for taking impressions of thebore with guttapercha. The insulated conducting wires attached to each interrupter pass out the muzzle to the chronograph. The devices being in place, their positions are determined by a measuring rule in serted at the muzzle. A difficulty experienced was that the first interrupters and wires in being ejected were liable to strike the succeeding ones before the arrival of the projectile and thus give a false signal.

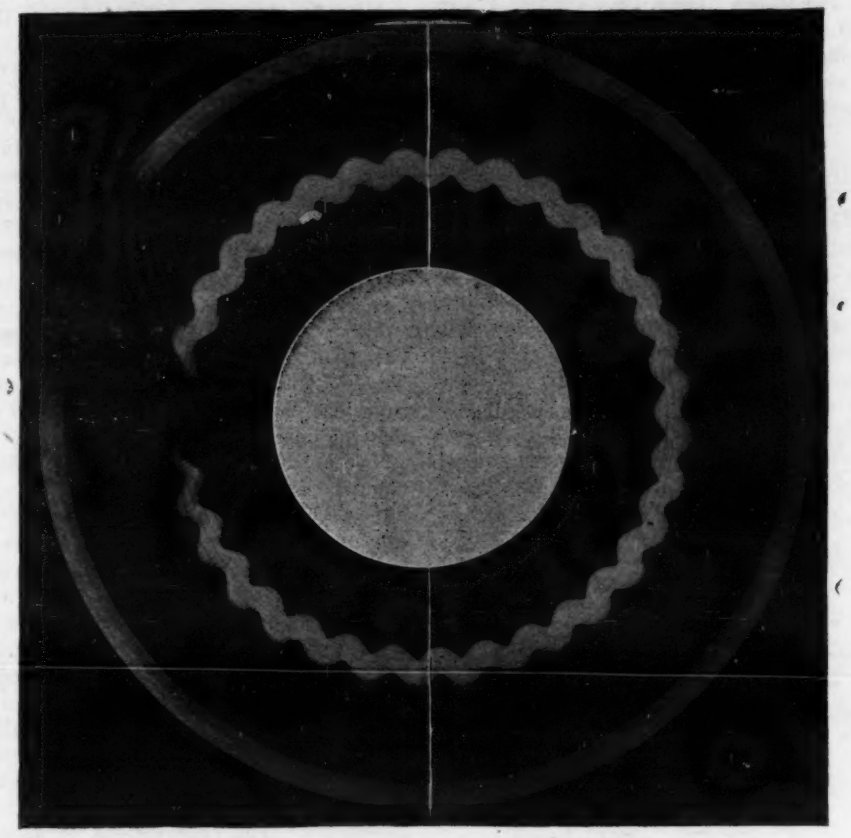


Fig. 2.

THE IMPROVED INSTRUMENT.

In a former paper already referred to, a full description of the instruments used was given. Many important improvements, however, in details which add to the efficiency of the instrument, were developed during the progress of these experiments, although no change was made in any essential principle. The month of July was devoted to various necessary preparations to facilitate experimenting, which proved a great saving of time in the end ; such as installing a suitable storage battery, constructing a universal mercury switchboard, testing different carbon bisulphide tubes, perfecting tuning fork records, securing and testing a good projection lamp, etc. One of J. B. Colt's projection arc lamps was tried in the hope that a light might be found which would not show such variable illumination when subjected to the instantaneous test as those formerly used had done. The illumination obtained even with such a sensitive test as was applied remained perfectly steady, and compared favorably with sunlight, as a reference to any of the records will show. Having obtained a perfectly satisfactory source of artificial light energized by a storage battery, the great advantage over sunlight, in being always ready, need hardly be mentioned. Naturally the subject of sizes and forms of glass tubes for the carbon bisulphide, and the manner of obtaining the requisite ampere-turns, were matters of early consideration, and several tubes were obtained for test. It was found that by introducing a condensing lens immediately in front of the arc a greater intensity of light was obtained upon the plate than formerly.

One of the most unsatisfactory features of the original instrument was the small amplitude of the waves of the tuning fork, and special attention was given to improving this. The diagram (Fig. 1) shows the principle of an improved method of obtaining a fork record, which gave beautiful results and greatly increased the possible accuracy of such records. While the plan of optically magnifying the amplitude of the waves had already been successfully accomplished by us, yet the idea of further increasing the accuracy of such records had been beautifully carried out by Lieut. B. W. Dunn, Ordnance Department, U. S. A., in some experiments which have unfortunately not yet been published. The same arc lamp was used for both the chronograph and tuning-fork records. A plane mirror *M* reflected the light through a condensing lens *L* upon a thin piece of aluminum foil glued to one prong of the fork *F*. In this foil was a smooth, round hole about one millimetre in diameter. A lens *L'* focused this brightly illuminated hole as an object upon the sensitive

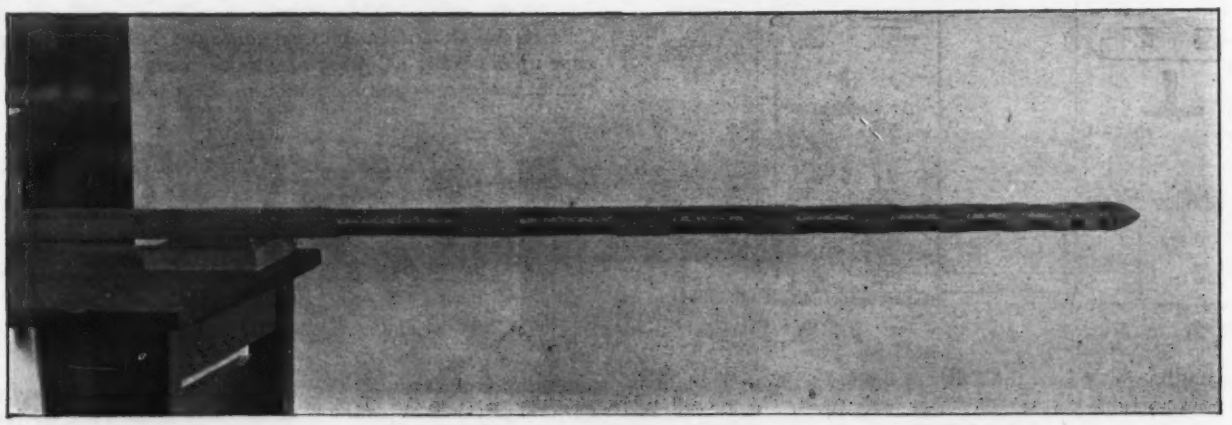


Fig. 3.

* Extraits du Memorial de l'Artillerie de la Marine. U. S. Ordnance Notes No. 318, by H. Sebert.

plate, and at the same time magnified it to about six millimetres. The fork was excited by drawing a wedge from between the prongs in preference to using any electrical method, as this was found to be convenient and satisfactory.

When one prong of a fork is allowed to cast its shadow through a narrow slit upon a moving plate the result is that a single sinusoidal line divides the region of light from the shadow of the fork. At the same time the other edge of the fork gives another similar sinusoidal curve which is ordinarily separated from the first curve so as not to interfere. By having two slits near together, one above another, a second shadow would fall on the plate having an exactly similar wave for its boundary, but it would lag behind the first wave by an amount depending upon the speed of the plate and the distance between the slits. This would therefore intersect the first wave at regular intervals of a wave length, and by the points of intersection make it possible to measure with great nicety the value of a wave length. Instead of having two slits the same object was attained by allowing the illuminated image of the magnified hole in the piece of aluminum attached to the fork to fall upon the plate. Those parts of the image which fell somewhat behind the rest gave waves differing in phase with the other part, so that the results like that exhibited in Fig. 2 were obtained. It is noticed that a cone of darkness intersects a cone of light, the dark region having had no exposure, and the light cone, so to speak, a double exposure. The fine circular lines seen are shadows cast by ordinary hairs fastened across the slit. They serve merely as references circles by which the centre of revolution may be accurately found. To allow the whole area of the magnified image of the illuminated hole to fall upon the plate, a square hole of suitable size filed away from the jaws of the camera slit opposite the point where the tuning fork record was to fall.

METHOD OF EXPERIMENTING.

After considering a number of different ways to measure interior velocities without mutilating the gun, that seemed to be the more promising, with the instruments in hand, which had for its fundamental idea the extension of the projectile forwards in the bore by some rigid body attached thereto, and measuring the motion of this prolongation, assuming it is the same as that of the projectile.

A wooden rod was attached to the projectile and extended along the axis of the bore beyond the muzzle. Two brushes were attached to the muzzle to preserve continuous contact with the rod as it passed out of the bore. Strips of sheet copper were fastened at chosen intervals to the rod, which served to make and break electrical contact between the two brushes. Trials with this method seemed to show that the difficulty was in keeping two brushes in continuous electrical connection with the rod as it passed out. The centrifugal force due to the rifling also has a tendency to cause the rod to be displaced from the brushes.

The difficulty of keeping two brushes in electrical contact with the rod with such high velocities attracted us to some method by which a *single* brush at the muzzle would be sufficient. Such a method became possible if electrical contact is maintained between the gun and projectile during its passage through the bore, for this contact can be substituted for one of the brushes. An experiment was tried with the special object of ascertaining if this contact is maintained as the projectile passes out the bore which resulted in this method being adopted.

A Single-Ring Brush.—The possibility of utilizing a single-ring brush according to the plan conceived seemed now established. This plan involved making the gun itself one terminal of the chronograph circuit, thus utilizing the connection between projectile and gun as one of the brushes. From the projectile the current passed along a wire, embedded in the wooden rod and connected with all of the copper bands, to the single brush at the muzzle which formed the other terminal of the chronograph. As a single brush could now be used, the advantages of one in the form of a ring entirely encircling the rod were at once apparent, for no matter which way the centripetal force urges the rod, a good contact with the ring is always assured, and furthermore the same ring may serve as a guide for the rod in its passage out of the bore.

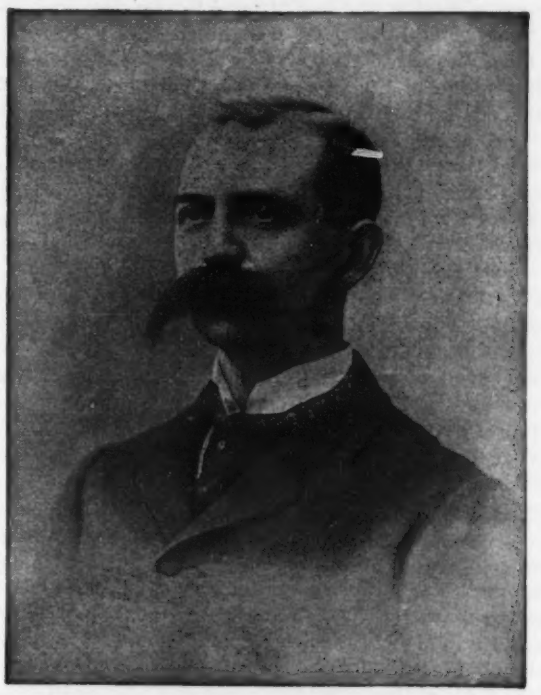
The Accurate Cylindrical Rod.—A cylindrical rod of light white pine wood was accurately turned with a specially devised tool to a diameter of 1⅝ inches. As the tool advanced the rod was polished by a tightly fitting iron collar supported from the tool rest. Notches were then cut at the desired intervals to accommodate the copper bands, which must be flush with the surface of the rod, by simply lowering the cutting knife and running the tool in the opposite direction along the rod.

Copper Conductors Added to the Rod.—When the rod was turned a groove was cut along its entire length to accommodate a copper wire to be buried in it. Thin copper strips ⅛ inch thick were cut to the desired lengths, and each made just long enough to completely encircle the rod without overlapping. These strips were first rounded between rollers, then around the rod and drawn very tight and close by winding a leather strap around it and drawing taut. Each edge was then secured by driving small brads closely along its length near the seam. The embedded wire was next soldered to each strip of copper to secure good contact. Between the copper bands, in addition to the wire being sunk beneath the surface of the wood, further guard against metallic contact with the brush as it passed through was afforded by filling the groove flush with the surface with sealing wax. The rod was next replaced in the lathe and polished to an accurate smooth surface.

(To be continued.)

The Death of Mr. H. J. Smith.

The late Harrison J. Smith, whose death and cause thereof were announced in the last issue of THE ELECTRICAL WORLD, was born in Hector, Schuyler County, N. Y., in 1854, and received a common-school education in Elmira. During his early life Mr. Smith worked as a carpenter in the Pullman car shops, and subsequently as a machinist on engine construction. He also fired a locomotive for a short time. In 1881 house carpenters were advertised for by the Edison Electric Illuminating Company, of New York, in connection with the construction of the historic Edison station in Pearl Street, and Mr. Smith with a few others was engaged. He continued with the company as carpenter and machinist until 1883, and after an interim of a month, entered the meter department and subsequently became its



HARRISON J. SMITH.

head. He left the company for about a year to engage in the wiring business, but returned in October, 1885, as electrician of the Pearl Street station, under Mr. Chinnock, and subsequently became superintendent of the first district. Later on he was appointed general operating superintendent of the company, which position he occupied at the time of his death.

Mr. Smith was a Knight Templar, an Odd Fellow and a past master of a New York lodge of Masons. His sudden taking off has awakened the deepest sympathy in the electrical profession for the family in their profound bereavement.

A widow, two daughters and a son survive the deceased. The funeral took place on Thursday, June 18.

A 180-HP Wave-Motor.

According to our San Francisco contemporary, the *Journal of Electricity*, a wave-motor installed in a bay at Capitola is running in good order and is developing as high as 180 horse-power.

First Convention of Street Lighting Officials.

In the City Hall of New Haven, Conn., last Thursday and Friday, June 18-19, there assembled upward of 50 municipal officials —superintendents, inspectors and aldermanic committees—having in charge the matter of street lighting in the various cities from which they came. The gathering was in response to a call issued by the Lamp Committee of the New Haven City Government, which promised interesting papers by eminent and practical men upon topics of especial interest bearing upon the lighting question, the discussion of practical and difficult problems by superintendents and inspectors, and exhibits of street lighting apparatus and appliances, all of which was with the view of arousing interest and enthusiasm to the point of a permanent organization, which was finally accomplished.

The meeting was called to order in the afternoon of Wednesday by Dr. B. L. Lambert, chairman of the Lamp Committee of New Haven, who was elected temporary chairman, Mr. Henry A. Knight, Superintendent of Lights, of Worcester, Mass., being chosen temporary secretary. After the appointment of a committee to report as to the advisability of effecting a permanent organization, Mayor A. C. Hendrick was introduced, delivering the address of welcome and expressing the sentiment: "From this small acorn may an immense oak grow." His address was followed by remarks from Dr. Lambert as to the objects and hopes of the meeting, after which the following papers were read: "General Street Lighting," by Hon. Walton Clark, General Superintendent United Gas Improvement Company, of Philadelphia; "The Municipal Ownership of Gas and Electric Plants," by Hon. T. B. Persse, of Hartford, Conn , and "Welsbach Street Lighting," by F. P. Merrill, manager Welsbach Street Lighting Company of America, Philadelphia. The meeting adjourned then to enjoy the hospitality of the city, a shore dinner having been provided at Lighthouse Point.

An evening session was held from 8 to 11 o'clock and the following business was transacted: "Lights of the Future," by James MacDonald, president New Haven Board of Aldermen; "Municipal Advantage of Electric and Gas Plants," by Allen R. Foote; "Relation of Lighting Corporations to Municipal Corporations," by Col. N. G. Osborn, Editor *New Haven Register*; "Lighting for Residential Streets," by J. D. Dervell, Jr., president New Haven Board of Councilmen. Then followed an interesting discussion upon the papers of Mr. Persse and Mr. Foote on municipal lighting, by the Hon. E. W. Burdett, of Boston, general counsel of the Massachusetts Electric Lighting Association, D. Hunter, Jr., Superintendent of Public Lighting of Allegheny, Pa., and the Hon. Walter Clark. The Committee on Permanent Organization reported recommending: First, that a permanent and national organization was necessary; second, that a president, three vice-presidents, secretary and a treasurer and an Executive Committee of nine be appointed; that the matter of by-laws and constitution be referred to the committee to report at the next annual meeting, and that the time and place of the next annual meeting be determined by the Executive Committee.

Friday's morning session did not begin until after 11 o'clock, an enjoyable early morning carriage ride through and around the city having been tendered by the city, and the session continued uninterruptedly until final adjournment at 2.30 o'clock. Two valuable papers were read, "Electric Street Lighting," by M. J. Francisco, president Rutland (Vt.) Electric Company; and "Evolution of Artificial Light" (illustrated), by Henry Hopkins, Superintendent Street Lighting of New Haven, which concluded the reading of papers. Valuable and telling remarks upon the municipal lighting question were continued by Messrs. Burdett, Clark, Foote and others, at the conclusion of which the report of the Committee on Permanent Organization was adopted, and the following names being submitted for permanent officers they were duly elected:

President, Dr. B. L. Lambert, New Haven; vice-presidents. Henry A. Knight, Worcester, Mass.; Oliver E. Greene, Providence, R. I.; C. E. Thompson, Binghamton, N. Y.; secretary, Henry Hopkins, New Haven; treasurer, Joseph Burtis, Hartford, Conn. Executive Committee, the above-named officers and D. Hunter, Jr., of Allegheny, Pa.; Thos. E. Gibney, Fall River, Mass., and J. F. Fagan, Portland, Me.

The papers of the Hon. Walter Clark, F. P. Morrill, M. J. Francisco, Allen R. Foote and Henry Hopkins were practical, interesting and of positive value, as were also the discursive remarks of the Hon. Everett W. Burdett and D. Hunter, Jr. The paper of the Hon, T. B. Persse upon municipal lighting, while very able from the sentimental side, abounded with the usual "stock" of arguments in favor of municipal lighting, presented absolutely nothing new, except unkind and unjust references as against private corporations and officials, which were regarded unwise. They provoked retorts which might not otherwise have been made. It being generally understood, however, that municipal lighting would be the principal topic the private lighting companies were very naturally well represented, and the impression prevailed that never before had such formidable and telling arguments been made against the question.

A deserved vote of thanks was tendered Mayor Hendrick and the New Haven City Lamp Committee for the handsome entertainment provided and attention bestowed upon delegates and visitors.

Around the rooms on the walls were shields bearing the names of Franklin, Faraday, Windsor, Drake, Davy, Thomson, Edison, Welsbach and Murdock prominent in oil, gas and electricity.

Mr. F. A. Gilbert, president Massachusetts Electric Lighting Association; Mr. Everett W. Burdett, general counsel of the association; Mr. George W. Davenport, Mr. M. J. Francisco, Hon. Walton Clark, and Mr. Allen R. Foote were distinguished representatives.

The many courtesies of Mr. James English, of the New Haven Electric Company, and the attendance of Chairman F. E. Barker, of the Massachusetts Gas and Electric Light Commissioners were much appreciated.

The Welsbach Lighting Company of America, New York & New Jersey Globe Gas Light Company and the E. P. Gleason Manufacturing Company, New York, were the exhibitors.

The convention register showed the following list of delegates and visitors.

Chas. R. Lindsay, Jr., Philadelphia, Pa.
George S. Barrows, Philadelphia, Pa.
Henry A. Knight, Worcester, Mass.
M. D. Gilman, Worcester, Mass.
George W. Hill, Providence, R. I.
Thomas E. Gibney, Fall River, Mass.
C. D. Herring, New York.
D. J. Prendergast, Philadelphia, Pa.
Charles F. Hopewell, Cambridge, Mass.
Charles L. Burr, Springfield, Mass.
Zera W. Smith, Springfield, Mass.
W. J. McCann, Springfield, Mass.
R. F. Ross, Boston, Mass.
John A. Bowen, Norwich, Conn.
S. C. Norvile, Binghamton, N. Y.
J. H. Tobin, Binghamton, N. Y.
E. F. Gennert, New York.
Francis Billingham, New York.
A. W. Gilbert, Hartford, Conn.
William Jackson, Trenton, N. J.
James B. Bell, Trenton, N. J.
T. Beran, New York.
M. J. Francisco, Rutland, Vt.
N. E. Severson, Binghamton, N. Y.
John J. Gaffey, Newark, N. J.
John H. Haugel, Newark, N. J.
E. C. Brown, New York.
Welles E. Holmes, Newton, Mass.
George H. Elder, West Newton, Mass.
C. C. Simpson, New York.
F. H. Lane, Wallingford, Conn.
F. E. Barker, Boston, Mass.
C. E. Thompson, Binghamton, N. Y.
T. B. Persse, Hartford, Conn.
Oliver E. Greene, Providence, R. I.
Charles H. Nettleton, Derby, Conn.
Everett W. Burdett, Boston, Mass.
Frederick P. Morrill, Philadelphia, Pa.
A. B. Ellbeck, Philadelphia, Pa.
Walton Clark, Philadelphia, Pa.
William McGregor, Pawtucket, R. I.
John F. Fagan, Portland, Me.
Fred N. Mayberry, Portland, Me.
Thomas J. Flaherty, Portland, Me.
Charles D. Sherman, New Haven, Conn.
Mayor Levi E. Coe, Meriden, Conn.
A. H. Jones, Meriden, Conn.
George H. Yeamans, Meriden, Conn.
Herman Minkwitz, Meriden, Conn.
D. Hunter, Jr., Allegheny, Pa.
W. W. Bartlett, Springfield, Mass.
Charles E. Ladd, Springfield, Mass.
Riverius Marsh, New Brunswick, N. J.
D. W. Lee, Boston, Mass.
Mayor William S. Greene, Fall River, Mass.
C. N. Ruggles, Bridgeport, Conn.
C. A. Paul, Bridgeport, Conn.
Finton J. Kelly, Bridgeport, Conn.
Mayor Kilduff, Waterbury, Conn.
Mayor A. C. Hendrick, and B. L. Lambert, J. C. Kelley, C. G. Unger, E. M. Thomas, W. E. Petrie and Henry Hopkins, of New Haven, Conn.

Convention of the Canadian Electrical Association,

TORONTO, ONT., JUNE 17, 18 and 19, 1896.

First Day.

The sixth annual convention of the Canadian Elcctrical Association was opened in the Board of Trade Building, Toronto, at 2.30 p. m., Wednesday, June 17. While the attendance was lessened to some extent by the near approach of the general elections for the Dominion, yet there was a large representation of members from different sections of the country. The following officers were present at the opening of the convention: President, A. B. Smith, Toronto; secretary-treasurer, C. H. Mortimer, Toronto; executive committee, Messrs. George Black, Hamilton, J. O. Kammerer, Toronto; E. C. Breithaupt, Berlin; J. Carroll, Montreal; K. J. Dunstan, A. M. Wickens and J. J. Wright, Toronto.

The first item on the programme was the president's address, and Mr. A. B. Smith, who has shown himself a most efficient chief executive officer, launched into this in a thoroughly businesslike manner. While the address was brief, yet it was thoroughly comprehensive.

Notwithstanding the commercial depression, electrical industries in Canada may be said to be in a flourishing condition. The larger electrical manufactures are in full operation, and report a large increase in the output, and with many contracts on hand. It is likely that during the coming year their capacity will be considerably increased. The wonderful increase in the use of electricity for all purposes necessitates the installation of larger units. Dynamos that were considered colossal a few years ago are now being abandoned on account of their lack of capacity. This is leading to the equipment of the factories with more modern and powerful machinery for their production. The allied trades of the tool builder, machinist and engineer are all therefore receiving the benefit of this development of the electrical age.

Not the least of the current developments is the remarkable increase in the number and mileage of electrical railways. The electric motor, a short time ago considered as limited to urban and suburban work, is now usurping the functions of the steam locomotive, and it not too much to say that ere long we may expect to see it on our main lines of railway.

In other branches of electrical work, good general progress has been made in perfecting systems and methods at present in use, both electrically and mechanically. The telegraph, with its adoption of new and rapid and self-recording apparatus, and the telephone with its improvements in the long-distance transmission of speech, are fully keeping pace with improvements in other departments.

The association is to be congratulated on the promising outlook. It is likely that in the immediate future, with an improvement in the financial world, and as disturbing elements are eliminated, the developments will be even more rapid than in the past, and an era of greater prosperity than ever will be abundantly realized.

The report of the secretary-treasurer, Mr. C. H. Mortimer, showed that during the year 24 active members and four associate had been added to the membership roll, making a total of 229. The statement of receipts and disbursements showed that at the present date there was a balance of cash on hand of $297.50.

For two or three years very persistent efforts have been made by the Committee on Statistics, under the able chairmanship of Mr. E. C. Breithaupt, to gather information touching the electrical business in Canada. It has not been an easy task. In his report of this year the chairman stated that blanks had been sent out to those engaged in the various branches of the electrical business, asking for information, but comparatively few replies were received—not sufficient to make it possible to accurately summarize results. At the same time the value of complete statistics was emphasized by the committee, especially those bearing on central stations. The formation of a bureau of statistics was suggested, kept in the archives of the association. It was thought that information would be given in this way for private use, where it would not be furnished in some cases for general publication. However, the returns received would form a fair basis on which to continue the work, and it was recommended that this be done. Only three replies were received from municipal plants. Twelve companies only state that they supply current for power purposes and two only supply current for heating and one for electrical welding. One fact prominent is that the majority are operated only during a very short period of every 24 hours, mostly from dusk to midnight. In most of these cases it is probable that a sufficiently large motor could not be obtained to employ the stations during the daytime.

The first of the excellent series of papers on practical and technical subjects presented by the committee was that on "Acetylene Gas," by Mr. George Black, of the Great Northwestern Telegraph Company, Hamilton. This proved one of the most attractive papers of the convention. It was illustrated by experiments in the manufacture of this gas with model apparatus that Mr. Black had prepared. A measure of local interest attached to the paper from the fact that Canada claims Mr. Wilson, the inventor of acetylene gas, one of her own citizens, and for a considerable time he was a resident of Hamilton, though not born there. While Mr. Wilson's factory is in North Carolina, he has already commenced operations in Canada. At an early day it is expected that a factory, now being erected at Merritton, on the old Welland Canal, will be completed. And it is also stated that he has secured a very large amount of power in the Province of Quebec, where he intends to manufacture not only for Canada but for export to foreign countries.

This paper, although it was attentively listened to, and the experiments in the manufacture of gas made by Mr. Black watched and studied with interest by the convention, at the same time it provoked considerable adverse criticism, especially from the electric light contingent.

In the opinion of Mr. Wright, Mr. Breithaupt and others, the view taken by Mr. Black in his paper, which reflects the feelings of the inventor and those who had interested themselves in the manufacture of this gas, was altogether too optimistic. It was believed that they were very much out in their figures as to the cost at which this gas could be furnished to consumers. The very fact that it had been before the country for eight years and as yet had not come before the people in a commercial sense, was evidence that there was a weakness somewhere. In its use for domestic purposes, as the plan seemed to be to manufacture it on the premises, when one considered the risks and dangers attending thereto, it was doubtful if the people would take over kindly to it. Mr. Black replied to the various objections, and assured the convention that it would only be a short time now before this gas would be before the people, when practical demonstration of what it would accomplish would be the best answer to those who had raised the various objections.

Second Day.

At 10 a. m., Thursday, 18th, the convention resumed business, with the president, Mr. A. B. Smith, in the chair.

On resolution the invitation of Mr. Ross McKenzie, of the Niagara Falls Park & River Electric Railway, which road was placed at the disposal of the association should they visit the Falls, was accepted, and Niagara Falls will be the place of the next meeting of the convention, the date to be fixed by the executive.

Almost the entire time of the forenoon was taken up with the reading of a paper on meters by Mr. James Milne, superintendent of the Toronto Incandescent Light Company. The paper was one of considerable length, and was illustrated with views thrown on a canvas, which added much to its interest. Mr. Milne treated quite fully the history of various known meters, but favored specially the Edison chemical meter. The action of the inspection department of the Government in condemning the Edison meter was severely criticised. Mr. O. Higman, of the Inland Revenue Department, Ottawa, the officer in charge of electric light inspection, was, as a member of the association, present, and replied at some length to the criticisms of Mr. Milne and others. While Mr. Milne and the other electric light representatives felt that there was cause for complaint in the way in which the inspection act was operated, after Mr. Higman's address it was recognized that the Government were ready to do what was in their power to bring about a satisfactory condition of affairs, and the outcome of the discussion was the appointment of a special committee, consisting of Messrs. J. J. Wright, P. G. Gossler, A. A. Dion,

James Milne and E. C. Breithaupt, to consider the provisions of the Government Inspection Act and confer with the Department of Inland Revenue, touching the matter of meters and such other subjects as may rise out of the consideration thereof.

ELECTION OF OFFICERS AND COMMITTEES.

The election of officers and committees, which was one of the first items of business on the convention resuming work after lunch, resulted as follows: President, Mr. John Yule, Guelph; first vice-president, Mr. L. B. McFarlane, Montreal; second vice-president, Mr. Carl Breithaupt, Berlin; secretary-treasurer, Mr. C. H. Mortimer (re-elected). Executive Committee: Messrs. J. J. Wright, Toronto; A. M. Wickens, Toronto; K. J. Dunstan, Toronto; J. A. Kammerer, Toronto; George Black, Hamilton; Ross McKenzie, Niagara Falls; A. B. Smith, Toronto; John Carroll, Montreal; Charles Hunt, London, and F. C. Armstrong, Toronto.

Committee on Legislation: J. J. Wright, K. J. Dunstan, C. B. Powell, L. B. McFarlane and F. H. Badger.

Committee on Statistics: Messrs. Carl Breithaupt, John Yule and O. Higman.

A paper on electric railways was then read by Mr. F. C. Armstrong, of Toronto.

At 5 o'clock the members of the association, accompanied by several ladies, left by the steamer *Greyhound* for Lorne Park, one of the popular Summer resorts, about 10 miles from Toronto, where the annual banquet was held and a very enjoyable evening spent. The party returned to the city about 11 p.m.

Third Day.

The meeting on Friday was called together at 10 a.m. by past-President Mr. A. B. Smith, and having been formally opened, the programme consisted of the reading of the remaining papers of the convention. First of these was a paper on "Some Central Station Economies," by Mr. P. G. Gossler, of Montreal. This is a subject that has a wide interest to electricians in Canada, and was highly praised by the members. The author was commended for the very full and complete manner in which he had dealt with the question.

The paper by Mr. George White-Fraser, of Toronto, on "Power Transmission by Polyphase E. M. Fs." produced considerable discussion. Mr. A. A. Dion, of Ottawa, expressed the views of the convention, when he said that the paper was specially to be commended for the clearness with which the phenomena had been explained by Mr. White-Fraser, whilst his plea for good engineering was one that ought to carry weight with every electrician. The time had come when in the installation of large or small plants the experience and training of a competent engineer should be called into requisition.

The closing paper of the convention, on "Operating Engines Without a Natural Supply of Condensing Water," by Mr. E. J. Phillips, of Toronto, was read by Mr. A. M. Wickens, it not being possible for the author to be present. Owing to the nearness of the hour of closing the convention the paper was not discussed at any great length, but it was suggested because of the importance of the subject that Mr. Phillips be requested to amplify the paper for another convention, to be read at a time when the subject could be entered into with greater fullness.

At 1 p. m., after the usual vote of thanks to various officers, the press, and others, had been passed, the sixth annual convention of the Canadian Electrical Association was brought to a close.

Convention Notes.

A feature of the meeting on the first day was a public illustrated lecture in the Board of Trade Rotunda, at 8 p. m., by Mr. James Milne, entitled, "Radiant Matter," showing Prof. Crookes' experiments and also demonstrations of Röntgen rays. Interesting shadowgraphs were exhibited. The lecture brought together a large audience of ladies and gentlemen, by whom it was thoroughly appreciated, and Mr. Milne won the thanks of the convention for the addition of this special feature to its programme.

After the adjournment of the convention on Friday a number of the members availed themselves of the invitation of Mr. J. J. Wright, of the Toronto Electrical Light Company, for a sail around the lake in his steam launch.

Mr. A. M. Wickens, in the course of a discussion on the closing day of the convention, expressed the view that the papers this year were more than usually of a high order, but he felt that the convention did not fully meet the needs of the smaller men engaged in the electrical business. It had been remarked to him by a visitor from Great Britain, that every hamlet in Canada seemed to be lighted with electricity. There were certainly a large number of station men at small points whose interest it would be well for the association to study in the future. This feature of the electrical business was growing.

While the near approach of the elections had caused a number to remain away from the convention, yet the opinion was given out that the attendance was the best of any convention in the history of the association, evidencing the general interest taken in its affairs.

During the sail on Wednesday evening to Lorne Park, Mr. A. B. Smith, the retiring president, was presented with a cane, as an expression of goodwill of his fellow members, and no vote of thanks on the closing day was more heartily endorsed than that to Mr. Smith for his services as presiding officer during the year, and for the very active interest he had for a number of years taken in the affairs of the association.

ACETYLENE GAS.

The first paper presented was on "Acetylene Gas," by Mr. Geo. Black.

The author, after first reviewing the characteristic properties of calcium carbide and the results of tests hitherto published, stated that the incandescent light has held first place for interior illumination on account of its steadiness, purity, coolness and not withdrawing oxygen from the air nor adding noxious elements to it. Acetylene will divide this field with the incandescent bulb; it is a pure, white, steady light, of low heating power, withdraws very little oxygen from the air and does not add impurities to any great extent. Its flame has a temperature of 900 to 1000 degrees C., while ordinary gas has 1400 degrees C., but as only one-tenth to one-fifteenth of the quantity is used for equal light, its heating effect is slightly in excess of the incandescent bulb.

Taking the theoretical E. H. P. necessary to produce one ton of carbide as 3000-hp hours, and using the same for a supply of electric light by incandescent 4-watt lamps, we have the following: $3000 \times 746 = 2{,}238{,}000$ watts $\div 64$ gives 34,970 16-cp lamps for one hour, or 1453 burning 24 hours continuously.

The same power equals one ton carbide, which, burned in ⅓ foot burners, gives 31,500 16⅔-cp lights, or 1313 burning 24 hours. This gives a margin apparently in favor of electric lighting, but you cannot use all your electric lights at the source of cheapest production, nor run a continuous even load for 24 hours, but have in addition to sustain losses in distribution more than proportional to the distance conveyed; also lamp renewals. With the carbide it is different; it can be made at the place of cheapest production on a constant load night and day, and a small sum transports the carbide to any place desired, where it can be used to its full power without loss. Figure out the problem of transmitting electric current for use 10 to 100 miles from source of production and transporting carbide by freight the same distance, and the comparison will be largely in favor of carbide. Hence, for use in close proximity to the power-house on a steady, even load day and night, the cost will be about the same if power costs the same, but as that is not practicable in electric lighting, the margin is in favor of carbide, but not to such an extent as to seriously hurt the electric companies employing the best apparatus under the most improved conditions, as may be found in large cities; but it is possible in small towns where the best and most economical conditions cannot be obtained and a thorough manager secured, well up in the scientific as well as the practical conditions, electric lighting may suffer.

The ease of distributing acetylene is remarkable. Owing to its high illuminating power, very small main pipes may be used, and as frost does not affect it the pipes need only be laid below the surface, so that little or no expense need be incurred in piping a town. If the cost of mains equal cost of poles and wires the central station or gas house only requires a small tank for a generator and a gasometer of suitable size, as compared with engines, boilers and dynamos running when only one light is required.

We may then conclude that in the race for supremacy closer economy will be practiced, better service given, the public will be benefited, all will let their light shine to the best of their ability, and the one best deserving of patronage will survive.

POWER TRANSMISSION BY POLYPHASE E. M. F.

Mr. Geo. White-Fraser in a paper on power transmission by polyphase E. M. Fs., first touched upon the possibilities for developing power which exist in Canada, and then discussed the fundamental relations existing in polyphase current circuits, giving a description of the various forms of winding and the quantities of copper required in

each system. He concluded by saying that electricity is not the object, but the means; the object being to make money by the sale of power. The engineering must be decided by the commercial value of this power. Assume a water-power 10 miles distant from a manufacturing town, the energy of which is to be electrically transmitted. What loss is to be allowed in the line? Can we afford to lose a good deal in these lines, transformers, etc., and so reduce the size of our conductors and consequently our construction expense? or would it be better to keep the loss as low as possible, and save the power for sale? Engineering says you can make your loss as little or as great as you please, but commercial considerations say if power is more valuable than money it will pay to save all the power possible for sale, even at the expense of heavy conductors. If there be a large demand for power at a high figure, and the source of power is limited, it is best to waste as little as possible; if the supply be very large and the demand small, it may, on the contrary, be best to waste much in the lines, in order to reduce the copper cost. Here again commercial considerations are paramount, for it is obvious that if much power is to be lost in the line the generators and water-wheels must be sufficiently large to furnish this waste power, and therefore cost more money, and a balance must be struck. Once a decision has been arrived at as to the loss allowable, then engineering considerations must settle as to whether it shall be mostly ohmic or mostly inductive, and here comes in the question of frequency. The efficiency of machinery is not sufficiently considered, and yet has a most appreciable influence on operating costs. The conditions under which motors operate are generally such that, although they may be called upon for a comparatively large output now and then, their average load, the work they are required to do most of the time is greatly less than the maximum. Consequently it would appear that their efficiency at such average load is of more importance than their maximum load efficiency. If, therefore, the supply is limited and the demand great, the half load efficiency of the entire plant assumes great importance.

Every case of transmission should be considered on its merits, and the results worked out independently. A little more or less loss does not mean simply a little less or more copper; it means less or more power to sell—larger or smaller generating plant; it means less or more profit. In every enterprise there is a certain combination of machinery, lines, etc., that will secure the maximum of efficiency with the minimum of expense, and this will not be attained by either regarding it from the purely commercial standard of getting the cheapest, or from the purely engineering standard of putting in the scientifically best, but can only be attained by combining the two, and by clearly recognizing the fact that solid commercial principles enter into engineering as much as into pure business.

SOME CENTRAL STATION ECONOMIES.

Mr. R. G. Gossler, in a paper on "Some Central Station Economies," pointed out the necessity of having reliable records, setting forth the details of the operation. These are of special value in cases of reconstruction. The paper is based upon the reconstruction of a particular plant. In connection with a pole catalogue, giving the number and location of each pole, circuit maps were arranged, which consisted of diagrams for each circuit, showing the streets upon which the circuit ran, and the size and length of each section of wire or wires.

At the same time these records were being made out, transformer charts were prepared, which consisted of maps for different sections of the city covered by the different circuits. On these maps each transformer was located by a small square stamped on the map, and within this square was written the name of the customer being served from this transformer, the number of lamps installed, the revenue per year, the revenue per lamp per year, the estimated number of hours burned per lamp per day, and the probable number of lamps burning at any one time. There is also indicated on these charts the size and length of secondary wires from the transformer to the customer's cut-out. All this information was found necessary for the proper "bunching" of customers on the transformers and for the loading of the transformer.

Wherever possible, secondary systems were established, to which several transformers were connected in parallel, in which case the size of the secondary mains between the transformers was such that the drop in these mains was small compared to the drop in the transformers themselves; in this way the transformers were made to share, more or less, the load equally between them. When a secondary system of distribution was not economical, single transformers were located. In determining whether a customer was to be included in a bunch of customers, all of whom were to be fed from one transformer, or whether it was more economical to place a separate transformer, it was necessary to make an approximate estimate of the cost of locating the transformer for each case. When the interest on the cost of placing a separate transformer plus the cost of maintenance of the transformer was more than the interest on the cost of connecting a customer to a transformer feeding other customers, the connection in question was made to the transformer feeding the "bunch."

The author stated that a guaranteed transformer leakage should be obtained from the manufacturers; substitute these guaranteed leakages for the different sizes of transformers in a table and a comparative statement of the annual cost of different makes of transformers can readily be made from which the most economical type for the local conditions can be determined.

In connection with the above transformer construction, regulation and efficiency should be considered.

There is but one course to follow if the station be loaded with unnecessary transformer leakage, and that is to replace, at the earliest possible moment, the old transformers by new transformers, using secondary systems where economical, and by this replacement cut down operating expenses and increase the station capacity.

Lamps with long life are found to be inefficient; very efficient lamps are usually short lived. There is a point between these extremes which makes a lamp suitable for electric lighting station use. Using an efficient lamp increases the earning capacity of a plant and permits of using higher candle-power lamps with a proportionally less increase in cost. An increase in candle-power either by high candle-power incandescent lamps of high efficiency or small incandescent arc lamps, seems to be the best way to meet competition from gas, either with the ordinary or the "Auer" burner.

It has been advocated by some, to meet this demand for more light, to running the lamps at a voltage above that for which they are rated, thereby running the lamps at a high efficiency.

Conditions.—To determine what lamp is best suited for any electric lighting station, it is necessary to know the cost of producing current per lamp-hour, and having established this for any special make of lamp, the following formula will permit of a comparison of different makes of lamps and the determination of the best lamp for the conditions under which they are to run. In considering the cost of production per lamp-hour in connection with the lamp question, the cost of service may be divided into three parts:

A. That portion of the service per lamp-hour that is practically not affected by the average efficiency and life of the lamps and such portions of the maintenance, operating and general expenses, as is practically not increased by increasing the current consumption per lamp-hour.

B. The cost per lamp-hour, coal, water, interest and depreciation on the lines, dynamos, engines, etc., and such part of the expense of the service as increases proportionately to the amount of current served per lamp-hour and as the maximum station output.

C. The cost of the lamp per lamp-hour, and the expenses per lamp-hour for replacing exhausted lamps. This is equal to the cost of one lamp, plus the cost of exchanging one exhausted lamp, divided by the average life of the lamp.

Under the first division (*A*) should be included the cost of fuses, meters, transformers erected, and secondary connections, line construction, maintenance, etc., and such proportion of the operating and general expenses as is not increased by increasing the current consumption per lamp-hour.

Under (*B*) should be included that portion of the cost of service per lamp-hour exclusive of lamp renewals, that increases proportionately to the current consumed per lamp-hour.

These divisions of cost should be so made that the sum of *A*, *B* and *C* will represent the total cost of service per lamp-hour, the values of *A*, *B* and *C* representing the above divisions of cost having once been established for a lamp of any given efficiency and average life for any particular lighting station the cost of service per lamp hour for this same station with any other lamp which has a current consumption different from the current consumption of the first lamp, and having an average life of "*Y*" hours, would be $A + XB + C =$ the cost of service per lamp-hour, "*X*" representing the proportion between the current consumption of the lamps being compared, and "*C*" being the cost of one of the new lamps, plus the cost of replacing one exhausted lamp, divided by "*Y*," the average hours of life of the new lamp.

This formula applies for comparing the cost of producing light with lamps having different costs, efficiency and average lamp-life, when they are to be burned in the same plant and under the same conditions of average lamp-hours burned per lamp installed, and the same maximum number of lamps burning for a given number of lamps wired. Value (B) in this formula includes the coal consumption and the materials, which practically vary proportionately to the watt-hours output required for providing the light. It also includes the interest and depreciation on the plant, which must be enlarged when the lamps consume large amounts of current, because the generating and supplying capacity of the plant must be proportionate to the maximum output called for by the lamps. In many plants the interest and depreciation account will form quite a considerable portion of the factor B, and as a large value to the factor B makes a showing against the high consumption of current per candle-power-hour very bad, it would appear that any lamps installed that did not burn at the time of maximum current output from the station could be economically used of a poorer efficiency with longer life than lamps which do burn at time of maximum output, because any additional demand for current on a plant that is not a call for current at the time of maximum output, does not require an increase of plant capacity. In estimating the best efficiency per candle-power-hour, or per lamp-hour, for these lamps that do not burn at the time of maximum output, the cost of interest and depreciation entering into the factor B in the formula (in fact all the costs that increase proportionately as the size of the plant required to serve the lights wired) should be excluded from the factor B. The result is that lamps that do not burn at the time of maximum output can be economically used of considerably lower efficiency than lamps that do burn at that time.

Experimental Tests on the Influence of the Shape of the Applied Potential Difference Wave on the Iron Losses of Transformers.—III.

BY STANLEY BEETON, C. PERCY TAYLOR AND JAMES MARK BARR.

(*Continued from page 746.*)

Again, for the correction of the hysteresis loss we need only consider laws which hold so long as the wave form is constant. Under these circumstances the area of the P. D. wave varies directly as the R. M. S. value. Now the area gives us at once the maximum in action, and the corrected hysteresis loss is then got by a further reference to Fig. 9. The values thus obtained are given in column 4 of Table II. The corrected total loss is now determined by the addition of the eddy-current and hysteresis losses, from which we obtain the curve given in Fig. 10.

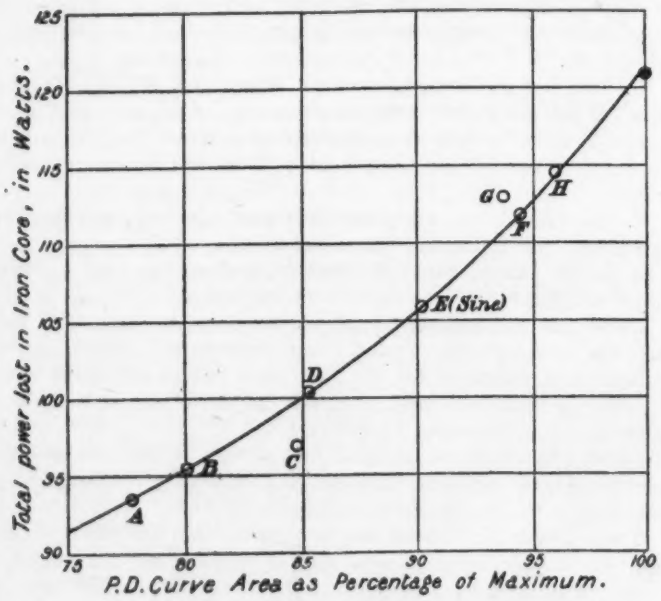
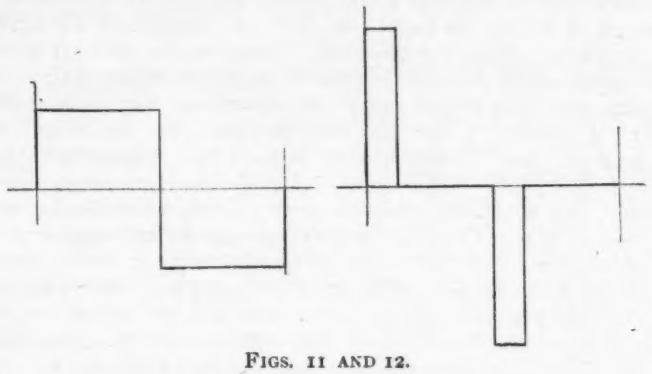


Fig. 10.

The Relation of the Iron Losses to the Area of the P. D. Wave.—In Fig. 10 we have shown the relation between the total power lost in the transformer and the area of the P. D. wave expressed as a percentage of the maximum area possible with the given R. M. S. value of 50 volts.[12]

This maximum area occurs with the rectangular shape shown in Fig. 11.

Such a rectangular wave would give the greatest possible value of maximum induction—in this case 3020 lines per square centimetre. On reference to Fig. 9, it will be found that the loss due to hysteresis corresponding to this value of maximum induction would be 88 watts; adding to this the constant loss due to eddy-currents—namely, 33 watts—the total power wasted in the iron comes out at 121 watts. This value must, of course, constitute the top limit of the curve shown in Fig. 10, since this wave-shape has the largest area possible with the given effective value.



Figs. 11 and 12.

It will be noticed that we have gone fairly close to the limit in this direction in our experiments.

The process of fixing the limit in the other direction consists of finding the shape of P. D. wave which will have the *smallest* area for the given effective value.

Now it will be obvious that before the area of a wave of constant R. M. S. value can be very much diminished *the maximum ordinate must of necessity be increased.* We cannot, therefore, diminish to any great extent the hysteresis loss without necessitating higher insulation.

If, on account of this difficulty, the maximum ordinate of the P. D. wave must have a definite limit (*e.g.*, maximum value not to exceed twice the effective value), the shape giving the least iron loss will be that shown in Fig. 12.

This is again rectangular, which may seem curious, but the essential point is to get as wide a peak as possible, and thus, as it were, confine the wave to one part of the period. This wave has been drawn to the same scale as the one given in Fig. 11. The area of the curve shown in Fig. 12 will be found to be exactly 50 per cent. of the possible maximum (Fig. 11); in fact, with waves of this type having a constant R. M. S. value, the area (and, therefore, the maximum induction) is inversely proportional to the maximum ordinate.

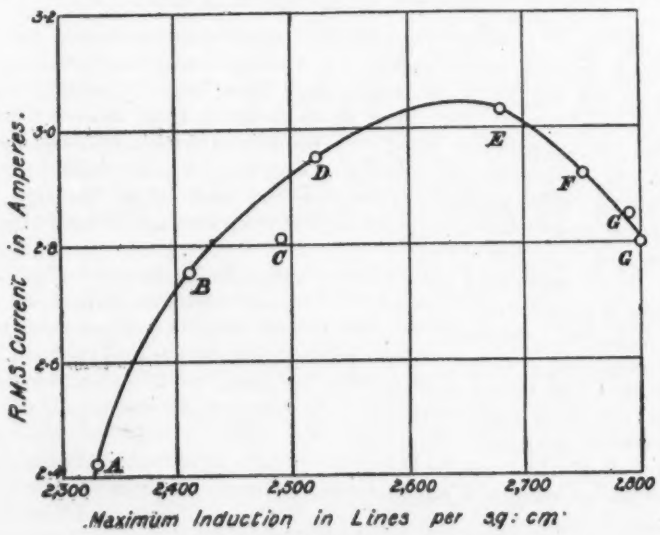


Fig. 13.

[12] It may be of interest to point out here that the ratio of the area of the P. D. wave to its maximum possible value is the reciprocal of the ratio more recently called by Dr. Fleming the "form-factor."

This gives us a measure of the minimum possible hysteresis loss with different allowable P. D. maxima.

It is evident that, *unless* the maximum ordinate of the wave is limited, its area can be infinitely reduced while its R. M. S. value remains constant.

Advantages of Peaked Waves of P. D.—Our lowest iron loss is

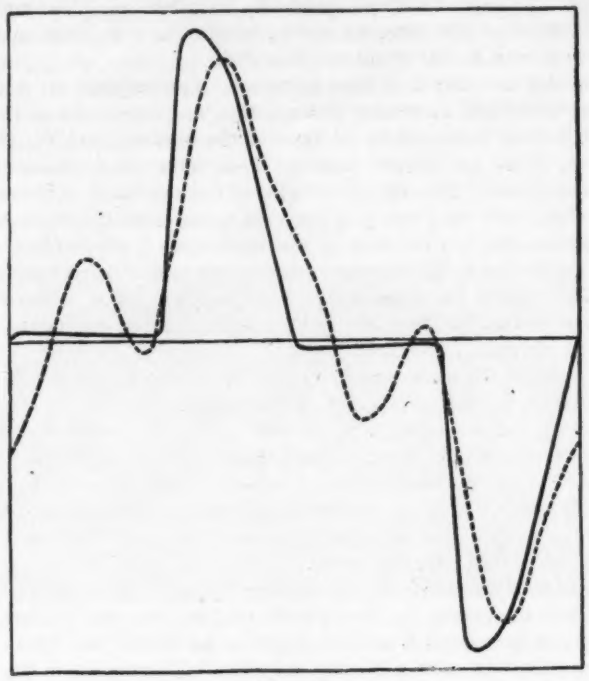


FIG. 14.

that given by the P. D. curve in Fig. 3 *A*. This is due to the fact that it approaches most closely to the form shown in Fig. 12, thus giving the least area, and, consequently, the smallest hysteresis loss.

It will be observed from Table 2 that there is a total variation of 22½ per cent. in the total iron losses. The consequent economy of using peaked waves of P. D., of course, becomes especially noticeable at low loads, but even at *full* load the saving thus effected is by no means insignificant. For let us assume that the efficiency of a transformer worked off the P. D. wave shown in Fig. 4 *H*, is 95 per cent. at full load, then, if the iron loss is, say, 2½ per cent. of the maximum output, we would increase the efficiency of the transformer to over 95¼ per cent. by using the P. D. wave shown in Fig. 3 *A*.

Under circumstances of cheap power production this saving may not be of extreme importance, but in systems of distribution or transmission of power where large transformers are used, the efficiency of

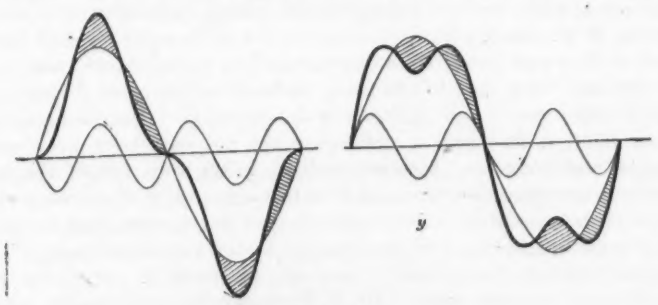


FIG. 15.

transformation is not the only question to be considered. One of the chief difficulties in designing large transformers is the providing of adequate means for keeping them cool, and any means by which the necessity for special cooling arrangements can be materially reduced will be sure to commend itself to those who have to deal with large transformers.

NO-LOAD CURRENT.

We have not been able to arrive at any satisfactory explanation of the variation of the no-load current with the shape of the applied P. D. wave. The curve given in Fig. 13, however, is interesting as showing that the maximum current occurs with the sine wave of P. D. The power-factor for this wave (Fig. 4 E,) is also the smallest (Table 1).

This is a distinct point against the use of sine waves of P. D. with transformers, especially in cases where many transformers have to be kept magnetized on light secondary load at the end of long mains; in cases such as these the main's losses—which vary as the square of the current—form a very appreciable item of the whole loss. The difference between the R. M. S. currents in cases *A* and *E*, for instance, is 25 per cent., so that the main losses in case *E* would be more than 50 per cent. greater than in *A*.

In order to arrive at a satisfactory explanation of the shapes of the current-waves, they must be considered as built up of two components—a hysteresis component and an eddy-current component.

We have split them up in this way in Fig. 3 and Fig. 4,; the hysteresis component was obtained from the induction curve by means of the B. H. curves in Fig. 8, and the eddycurrent by taking the difference between this and the total current curve.

It will be at once apparent that the peculiarities of the current-curves are due almost entirely to the eddy-current component; the hysteresis parts are all very similar in shape.

The roundness of the curves, especially noticeable in curves *B*, *C*, and *D*, is entirely due to the eddy-currents; the hysteresis component being in all cases comparatively flat on both sides.

The eddy-current components have been obtained by a somewhat complex method, and a discussion on the details of each one is therefore hardly justifiable; but as a class they exhibit some very interesting features, the most notable of which is that the curves are very nearly in phase with the P. D. waves.

Speaking generally, the curves also have shapes similar to the P. D. waves. This is a clear indication of the fact that the eddy-currents may be considered as equivalent to one current flowing in a supposed secondary circuit.

It follows from this that the eddy-currents have the effect of bringing the total primary current curve more nearly into phase with the P. D. wave, and thus tend to increase the power-factor.

It will be noticed that in all the curves, with the exception of Fig. 4 *E*, the eddy-current component leads slightly in front of the P. D. wave; it is, however, so slight that it needs some corroboration from other experiments. The only explanation possible seems to be that the plates of the core, being separated by insulating paper, form a condenser, thus causing a small capacity current as well as the ordinary eddy-currents.

NOTES ON INVESTIGATION BY DR. ROESSLER.[13]

The conclusions at which we arrived in August were partly anticipated, we found, by Dr. Roessler in a paper read in Germany in July, 1895, but not published in England until November. Dr. Roessler, however, since he could only experiment with two wave-forms of applied P. D., could not prove by experiments the results which he obtained theoretically.

We gather from an article in *The Electrician* on Jan. 10, 1896, that Dr. Fleming did not at that time consider it *proved* that the hysteresis loss in a transformer depended only on the form-factor of the applied P. D. wave—or on its area, which comes to the same thing.

Dr. Roessler's system of measurement differs very materially from ours. To obtain the power given to the transformer Dr. Roessler employed the usual form of dynamometer-wattmeter, with its necessary corrections, and this gave rise to some rather complex calculations with the different currents.

Dr. Roessler treats the question very largely from a mathematical standpoint, and introduces a correcting factor into his formulas for each typical wave-shape; but he does not appear to have fully appreciated the fact that the whole question of hysteresis loss is wrapt up in the *area of the applied P.D. wave*, independently of the R. M. S. value.

In this paper we have shown that it is the *area* alone which determines the hysteresis loss of a transformer.

Dr. Roessler makes some interesting comments on the equation,

$$E p_1 = J_1 \omega_1 + 0.4\pi \frac{n_1^2}{l} S \frac{dB}{dH} \frac{dJ_1^*}{dt},$$

in which $E p_1$ = primary P. D., J = primary current (both *instantaneous* values), n = primary turns, and l and S are respectively the length and cross-section of the path of the lines in the iron.

The following sentence occurs: "If * * * the alternator gives a very pointed potential curve, and very high maximum value, the

[13] *The Electrician*, November and December, 1895, vol. xxxvi., pp. 124-222.
*Electrician, Nov. 29, 1895, vol. lxxxvi., p. 153.

maximum value of $\frac{dB}{dH}\ \frac{dJ_1}{dt}$ must be very great. *But* $\frac{dB}{dH}$ *is independent of the alternate-current curve*" [the italics are ours], "and only depends on the hysteresis curve; hence the value of $\frac{dJ_1}{dt}$, which is simultaneous with the maximum value of the potential curve, must be greater with pointed curves than with flat."

This is not necessarily so, and the reason is this—that the value of $\frac{dB}{dH}$ *is* dependent on the form of the P. D. curve in so much as it is dependent on the point on the hysteresis cycle at which we are working, and this, again, on the part of the period at which the maximum value of P. D. occurs.

Compare Fig. 3 *A* and 3 *B*.

In *A*, when the P. D. is at its maximum, the induction curve has not crossed the zero line, and we are working at the point marked "*a*," Fig. 8; but when the P. D. is a maximum in *B* we are working at the point "*b*," Fig. 8; the value of $\frac{dB}{dH}$ at *b* is 70 per cent. greater than at *a*, and this is why the current-curve is so steep at the time of maximum P. D. in *A* and comparatively flat in *B*, although the maximum P. D.'s in these two differ by 10 per cent.

The steepness of the curve in *A* is also partly due to the eddy-currents; the reason for this is indicated on *b*.

In conclusion, we wish to thank both Prof. Ayrton and Mr. Mather for their kindness and help throughout these experiments; and we are especially grateful to Prof. Ayrton for the assistance he has rendered us in the preparation of this paper.

APPENDIX.

Before deciding on the method described in this paper for obtaining potential difference waves of any desired shapes, we considered the practicability of using a series of alternators coupled on one shaft. By this means various component harmonics differing in phase amplitude and frequency could be produced and combined to give any desired wave-shape.

This idea of combining harmonics to obtain prescribed results has been known for some time. Lord Kelvin used it in his famous tide-predictor, and it was afterward employed by Profs. Ayrton and Perry in 1877 in their apparatus described in a paper on "The Music of Color and Visible Motion."[13]

Although this method would have been in some ways very convenient, we were obliged to dismiss it as too expensive. It is also difficult to get waves of very great irregularity by this method. Dr. Fleming, in reference to this method,[14] remarked that three such alternators, giving frequencies in the ratio 1, 3, 5, would be sufficient for the majority of curves met with in practice. We were anxious, however, to experiment with waves *not* actually met with in practice, since our aim was not so much to find out which alternator now on the market was the best, but rather to give some information, if possible, which might be a guide in the future design of alternators for use on transformers.

On considering the question more fully, we also find that the first three odd harmonics given by the series of alternators just mentioned would not, in many cases of not very distorted waves, give a close approximation to the true shape; thus, we find that, in order to get a peak in one part of a wave, it is necessary to cause the rest of the period to consist of a series of irregular undulations. We cannot, in fact, by this method alter one part of the wave without getting into difficulties with the rest of it.

This point is brought out very clearly in Fig. 14. Here we show a wave which we have produced by our method of "injection,"[15] and also the wave given by the combination of its first three odd harmonics (dotted curve). It will be noticed that, though this wave approaches the desired shape at the peaked part, it is far from it during the rest of the period. The harmonics for this wave were obtained with one of Coradi's harmonic analyzers, by the courtesy of Prof. Henrici.

It is here that our method has one of its chief advantages. If we want a peak or a depression in one part of our wave, we make it, and leave the rest in peace.

The injector method is also one which may be adopted at very little cost. It may be argued that the condensers are expensive, but they are not *necessary*, as a great variety of waves can be got by injecting resistance, and using more than one pair of brushes (b_1, b_2, Fig. I.), and so getting more than one injection on each half-wave. It should also be remembered that, when using condensers, the greatest effect is got with the least capacity.

The effect of higher harmonics on the area of a P. D. wave (and consequently on the maximum induction) cannot be stated generally. But it may be of interest to indicate the general principles on which it rests. To do this a simple case may be taken as an example. It is only necessary to consider odd harmonics, as even ones make the waves unsymmetrical about the time line.

Consider the case of a third harmonic superimposed on a fundamental sine wave as shown in Fig. 15. The amplitude of the harmonic is here three tenths of that of the fundamental.[16] The two extreme cases are shown, namely, those with the harmonic in co- and anti-phase. The effective value of the resultant is the same in each case (viz., very nearly 4 per cent. greater than that of the fundamental), but in *x* the area of the semi-wave is *diminished* by that of a half-period of the harmonic, and in *z* it is *increased* by the same amount; this is the maximum effect possible, since, whatever the relative phases be, two of the half-periods of the harmonic cancel as regards area.

The area of the wave may therefore be *diminished or increased* by 10 per cent. by the addition of the harmonic.

The area of a sine wave of the same effective value as the resultants will be 4 per cent. greater than that of the original fundamental. Thus, by building up a wave of two harmonics such as here chosen, we may get resultants of constant effective value having areas from 6 per cent. greater to 13.5 per cent. less than that of the sine wave of that effective value.

It will be apparent from this reasoning that the effect of harmonics is entirely dependent on their phase relatively to the fundamental, and that attempts such as were made at the time of the "Sine Wave Controversy" to state generally the effect of harmonics in the P. D. wave on the iron loss of a transformer are quite futile.

DISCUSSION.

In the discussion which followed the reading of the paper, Mr. Fleming said that Dr. Rössler had described several months previously the investigations made with the machines giving E. M. F. curves in different forms. He thought that Dr. Rössler's conclusions covered practically those the authors arrived at. He thought that it had been well understood for a long time that the peaked form of E. M. F. curve gave the least loss or a smaller loss on the transformer than did a curve with a more rounded form. He mentioned two machines on one of the London supply stations, one of which gave 1000 volts more maximum pressure than another working on the same R. M. S. value. He considered that from a practical point of view the question of what form should be given to the E. M. F. curve must be governed not only by the question of the loss of the transformer, but also by the question of the secondary drop and the insulation difficulties that occur. His own feeling was that there was not a great deal which could be done in that direction, because of those two conflicting results arising from altering so much the E. M. F. curve. They could give it a little more peaked form and in that way diminish the hysteresis loss of the transformer, but at the same time they would bring themselves into other difficulties. He thought that it was perfectly well known that the forms which were likely to be useful in practice would not vary over very wide limits, and therefore, there was nothing in the mere fact of the discovery that some very unusual or extravagant form of curve would have certain peculiar difficulties in respect to the core loss, because that must be governed by the number of different conditions. The station engineer must consider not only the form of curve, but the qualities of the alternator. Mr. S. Evershed thought that it would hardly pay to design machines which would give any different wave from those now in common use. He said there were other considertions of far more importance than the actual shape of the wave. Mr. Carter disagreed with Mr. Evershed and considered the wave a very practical question. He wished that the discussion might be shared partly by American and partly by English engineers. Prof. Ayrton thought that the sine wave was neither very good nor very bad.

[13] *Physical Society*, Nov. 23, 1878.

[14] *Electrician*, June, 1895, vol. xxxv., p. 304.

[15] This wave, and the method of obtaining it, was given in *The Electrician*, June, 1895, vol. xxxv., p. 289.

[16] Unless the ratio of the maximum of the fundamental to the maximum of the harmonic is greater than the ratio of their wave-lengths, the curve will dip below the zero line at the ends of the half-period, in cases such as shown in *x*, Fig. 15.

An Experimental Study of Electro-Motive Forces Induced on Breaking a Circuit.*

BY F. J. A. MCKITTRICK.
WITH AN INTRODUCTION BY DR. EDWARD L. NICHOLS.

PRELIMINARY NOTE.

The method described by Mr. McKittrick in the following paper is one that has been developed by successive steps to meet the requirements of the study of fluctuating electric currents. As long ago as 1880 Joubert[1] introduced what has since proven an extremely useful method in the study of alternating currents, namely that of instantaneous contacts. This method was used independently and almost simultaneously by Thomas and Geyer[2] and has since been developed and perfected by Duncan[3], Ryan[4], Bedell[5] and many others. It has remained in use ever since and has been of the highest service. A variety of methods for the recording of current curves, principally by the aid of photography, have been added. The first attempt in this direction was made by Fröhlich[6] in his well-known experiments with a mirror mounted upon the diaphragm of a telephone. The photographic method has been further developed by Blondel[7] and others. In 1892 Moler[8] constructed a galvanometer the needle of which had a period so rapid as to make it possible to follow fluctuations the period of which did not exceed one one-hundredth of a second. In this instrument, as is well known, the record was made by the movement of a pointer over the surface of a smoked cylinder. Since the construction of the Moler curve-writing galvanometer, Hotchkiss[9] has busied himself with the development of an instrument the needle of which has a much higher rate of vibration. By means of this galvanometer, which is described in the succeeding paragraphs of this paper, a great variety of curves have already been obtained, and its application to the problems, studied by Mr. McKittrick, is herewith presented to the Institute in the belief that it will serve to illustrate the usefulness of the method in question.

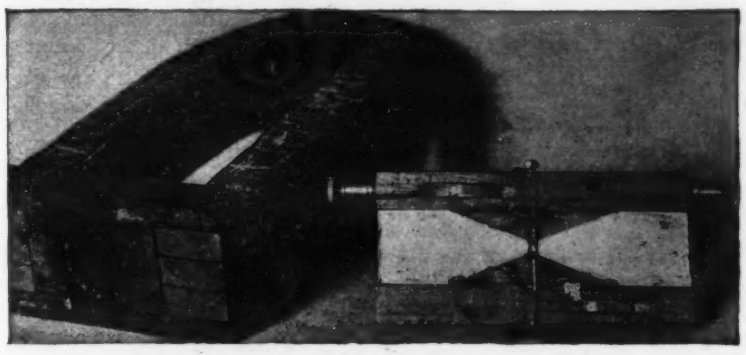


FIG. 1.

The present paper is an attempt to describe the results of an introductory experimental study of the induction phenomena exhibited when the above form of circuit is broken. The results presented must be regarded as chiefly illustrative, but it is hoped that they may be found interesting, perhaps useful, to the Institute, since the fields of all dynamos and motors are enormous electromagnets, and at every change of the current through them, E. M. Fs. are developed, a knowledge of which is essential to the electrical engineer.

In the galvanometer for photographing alternating-current curves which has been brought to such a high state of perfection by Messrs. Hotchkiss and Millis, we have an ideal instrument for studying such rapidly varying currents as accompany a break in a circuit. It was by the aid of such an instrument that the present work was done.

In the article cited above, the construction of this galvanometer is fully described. Since, however, the form used by the writer was modeled after later designs of Mr. Hotchkiss, it may be well to outline briefly the construction of the principal parts.

The apparatus in question is a photographic galvanometer. From a minute mirror attached to an equally minute needle, light from some source is reflected to a narrow slit past which a photographic plate is recording thereon any motion of the needle. In the experiments to be described, the needle used consisted of a minute piece of soft iron 1 65 mm by 1.07 mm and .07 mm thick, to which was attached a mirror .53 mm by .42 mm made from a silvered microscope cover glass. The needle and mirror are mounted on a quartz fibre. Lengthwise of a brass rod .32 cm in diameter is cut a slot .16 cm wide, of equal depth, and about 3 cm long. At the bottom of this slot and about the middle of its length, a hole, the same width as the slot and .7 cm long, is drilled through the remaining portion of the rod. To the shoulders thus formed the quartz fibre is attached, suspending the needle and mirror in the middle of the hole. This brass rod and the needle suspended in it can be seen in Fig. 1.

From the vibrations of a standard tuning fork (768 vibs.) photographed on a plate with those of the needle, the period of the needle is easily found. It is 2656 complete vibrations per second.

The general construction of the galvanometer can be seen from Fig. 1. The permanent horseshoe magnet has a length of 20 cm and a total width of 10.8 cm. A block of wood 10.8 cm by 4.9 cm by 1.6 cm slips over the ends of the magnet as shown, while in a second block 10.8 cm by 4.9 cm by 2 cm is a groove 2.5 cm wide and 1.5 cm deep, carrying the tapering pole-pieces as shown. The two coils of the galvanometer are fixed by paraffin in holes 2.5 cm in diameter and 1.7 cm deep, bored, one in each block, so that one coil is flush with the surface of the first block, and the other with the bottom of the groove in the second. These two blocks are placed face to face and fastened by screws. The brass wire containing the needle is slipped vertically down between the coils and the pole-pieces as shown. Connection between the two coils is made by a spring, the other terminals being connected to binding-posts.

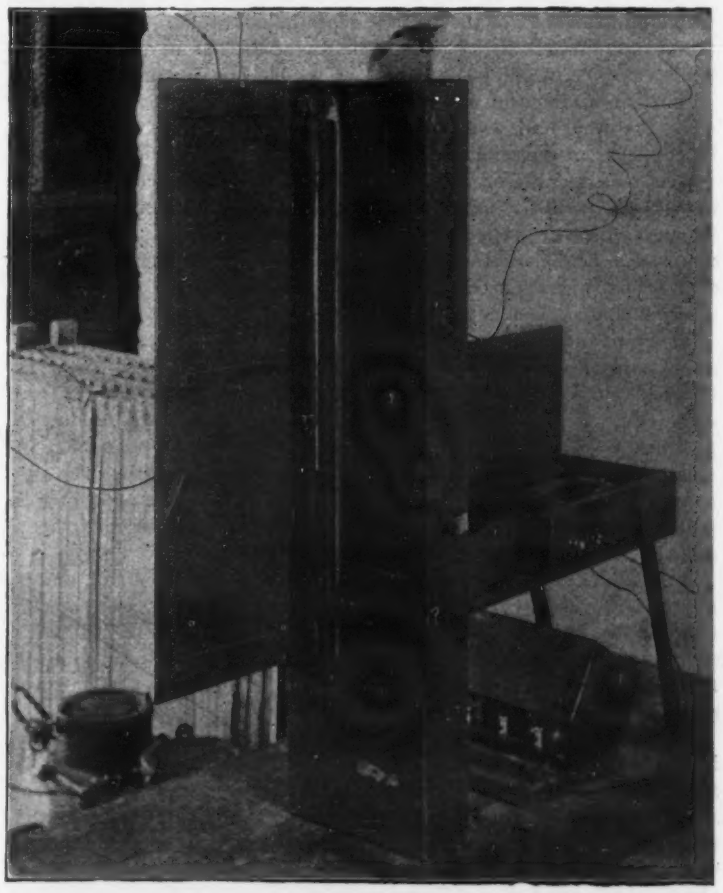


FIG. 2.

The coils of the galvanometer were wound with No. 36 B. & S. copper wire on a standard form used by the mechanician of the Physical Department for the construction of the most sensitive galvanometers. The resistance of the coils in series is 270 ohms at

* Presented at the General Meeting of the American Institute of Electrical Engineers, New York, May 20, 1896.

1. Joubert, *Journal de Physique*, 1880.
2. Thomas and Geyer; A. I. E. E., vol. viii, p. 393, vol. ix, p. 263.
3. Duncan, Hutchinson and Wilkes; THE ELECTRICAL WORLD, vol. xi, p. 160.
4. Ryan; A. I. E. E., vol. vii, p. 1.
5. Bedell, Miller and Wagner; A. I. E. E., vol. x, p. 498. (For further references see the last named paper)
6. Fröhlich; *Elektro-technische Zeitschrift*, vol. x, p. 345.
7. Blondel; *La Lumiere Electrique*, vol. xli, p. 401.
8. Moler; A. I. E. E., vol. viii, p. 324.
9. Hotchkiss and Millis; *Physical Review*, vol. iii, p. 49; also F. E. Millis, *Physical Review*, vol. iii, p. 351.

18 degrees C., while the self-induction is so small that attempts at determining it have led to negative results.

The pole-pieces mentioned above and shown clearly in Fig. 1, were made of soft iron 2.5 cm wide and .5 cm thick. Each was 3 cm long and tapered to a tip .5 cm by .2 cm. They fitted tightly into the groove, and were adjusted by microscope to equal distances from the needle.

In order to protect the photographic plate from light, the part of the apparatus shown in Fig. 2 was constructed. The vertical slide, in which the plate drops, is 18 cm by 7.5 cm and 90 cm long. In the

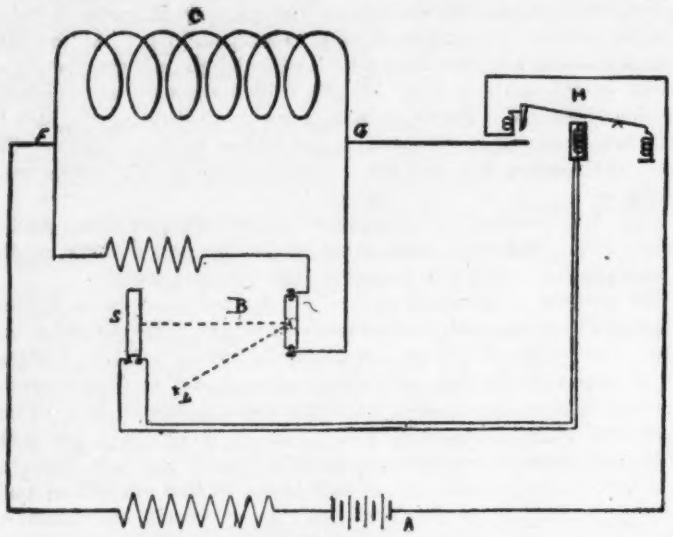


Fig. 3.

inside of the slide, two cleats extend the length of the box between which and the back of the box the plate-holder drops. One cleat extends only to within 23 cm of the top of the box in order that the holder may be placed in position. A second box 48 cm by 18 cm by 10 cm containing the galvanometer is attached by one end to the slide, the other end being supported by legs. Where the boxes are in contact, an opening 1.7 cm by 15 cm is cut through both, and across this opening on the inside of the slide is pasted a piece of cardboard having a narrow horizontal slit 12.7 cm by .05 cm and through which the reflected light from the galvanometer passes to the plate. Light passes to the mirror of the galvanometer through a vertical slit in a shutter-slide shown clearly in Fig. 2. This shutter is adjustable about a vertical axis at the end of a box.

The galvanometer is so supported that it is adjustable by hand about a vertical axis passing through the needle, while a screw at the end allows delicate adjustments to be made about a horizontal axis. Before dropping, a brass catch holds the plate holder in position, from which it can be released at will, while a cushion of waste at the bottom of the slide diminishes the shock of the drop and a small spring catch prevents a rebound. The whole apparatus is painted a dead black, while felt attached to the doors serves to keep out all useless light.

A small mirror which is attached to the galvanometer itself, and is adjustable, was used to trace out a reference line as seen on the curves. By it an exact zero line could be obtained, but only with great care in adjustment. Since in general an absolute zero line is not necessary, this mirror was usually only adjusted to trace an approximate zero line.

The arrangement of apparatus during the investigation is shown in Fig. 3, in which *c* is an electromagnet through which current is flowing from a battery in the branch *a*; *b* represents the galvanometer placed in series with a high resistance in parallel with *c* at the points *f* and *g*; *l* is the arc lamp, and *s* the slide in which the plate drops; *h* is a form of circuit-breaker placed in *a* and controlled by an electromagnet operated by an auxiliary circuit. When a current is flowing in this auxiliary circuit, the terminals in the breaker are held in contact against the force of a spring and the circuit through *c* is complete. The plate holder in dropping operates a trip which breaks this auxiliary circuit, and hence the main circuit, the effects of the break being recorded on the plate.

The circuit-breaker used consisted of a modified form of telegraphic sounder. The framework which usually limits the motion of the armature lever was removed, and the lever itself lengthened. To the end of this lever, at right angles to it, and in a vertical plane, was fastened the metal forming one terminal, to which was attached a wire carrying the current. This wire was so flexible that it did not materially interfere with the motion of the lever. The upper terminal consisted of a strip of metal about .04 cm in thickness, tapering to a width of about .2 cm. The other terminal was a sheet of the same metal about 5 cm square, placed horizontally beneath the upper terminal.

The source of light used was an arc lamp fed by hand, and enclosed in a box, in the front of which a vertical slit .5 mm in width allowed the light to pass to the mirror. The carbons were tilted at an angle of about 30 degrees in order that the brightest light from the crater might be reflected to the plate.

Since the phenomena which we wish to study occurs when the circuit *a* is broken, it is well to examine what happens when a circuit through which a current is flowing is opened, and by what law the current falls to zero.

As we open a metallic switch, for example, an arc is formed through which the current continues to flow until the terminals of the switch become separated so far that the E. M. F. of the circuit is unable to force a current across. The spark then breaks. What actually occurs in the formation and rupture of such an arc is unknown. The nature of the arcs so formed must vary under different conditions of breaking and the law by which the current reaches zero in each case must vary with the arc so formed and its time of duration.

It has been established theoretically and verified experimentally, that, on the removal of the impressed E. M. F. from a circuit, the current reaches zero by a logarithmic curve. That the current curve under the conditions of an ordinary break may differ widely from a logarithmic curve can be easily understood. That such actually is the case can be seen from Figs. 4 and 5, which show the dying away of the current, when a simple circuit is broken. These curves were obtained by connecting the galvanometer just described, in parallel with a non-inductive resistance of 3.385 ohms, placed in series with the coil *c* used during the present investigation, and breaking the current in the manner described above.

In Fig. 4 the three curves represent a "break" under different conditions. The curves are traced from left to right. The three straight lines are the three reference lines, approximately zero lines. Beginning at the left, the straight part of each curve represents the steady deflection of the needle, the distance of this deflection from the zero line being proportional to the strength of the current. The point at which the "break" begins is clearly marked by a slight notch. From that point the curves fall away approaching the reference line slowly at first, abruptly at the end. From the point where the "break" ends, the curves run parallel to the reference line.

Fig. 4 (1) is a "break" in which the terimals of the circuit-breaker are of copper, *e*, the E. M. F. of the circuit is 170 volts, *l*, the self-induction, 0.29 henry *I* and , the current flowing before the "break," 5.2 amperes. The time taken by the spot of light to trace out any part of the curve is found by comparing the curve with the vibrations of a tuning fork of known pitch photographed on a plate dropping at same speed. Since in all cases the plate-holder fell

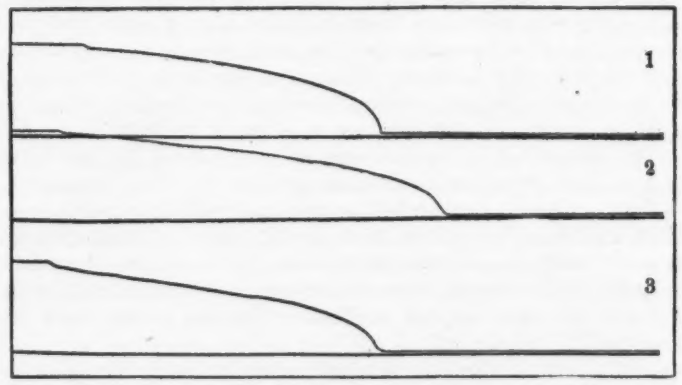


Fig. 4.

quite freely, it can be assumed that the speed of all plates in passing the slit was the same. The duration of the spark in Fig. 4 is in this way found to be .065 second.

Fig. 4, (2) shows a "break" when the breaking terminals were of brass, all other conditions remaining as in (1). The time of duration of the spark is 075 second.

Fig. 4 (3) shows a "break" under the same conditions as (2), except that the spring of the circuit-breaker is strengthened, thus separating the terminals more quickly, and hastening the destruction of the arc. The time of duration of the spark is .068 second.

(To be continued.)

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

LIGHTS AND LIGHTING.

Alternating Arcs and Wave-Forms. BLONDEL. Lond. *Elec.*, June 5; a brief communication in reply to the one of Steinmetz (see *Digest*, June 13).—He claims that Steinmetz's historical sketch is misleading as he makes no reference to the first and more important works on the subject of alternating-current arc curves; the first indication of a distortion of a sinusoidal into a rectangular wave, was given by Joubert in 1881 and referred to by Hopkinson in his celebrated paper on alternating currents; Steinmetz's paper of 1892 was anticipated by six months by a paper of Blondel; the question of the distortion of waves by the alternating arc, he claims, was fully analyzed for the first time in a paper read at the Chicago Congress (presumably by Blondel); this he claims shows that the conclusions of Steinmetz and Frith are equally incomplete because they have not taken into account the nature of the carbon. With the same alternator, feeding an arc lamp, voltage curves of the most varied character can be produced according to the material of the core, the length of the arc, and the amount of self-induction; it makes little difference whether this self-induction is inside or outside the alternator; with the low voltage carbons usually used in Europe in 90 per cent. of the plants, the arc alters the wave-form very little; to get the flat-top curve, it is necessary to use high-voltage or coreless carbons, and only two lamps in series instead of three, on 110-volt circuits; high-voltage carbons alter the curve by making it flat-topped, even with low self-induction machines, notwithstanding Mr. Steinmetz's opinion to the contrary; the difference obtained by introducing high inductance is to make the ascent of the curve steeper; all alternators may give the same curve with an arc when the lamps are provided with sufficient inductance; highly inductive alternators are not at all adapted for studying the arc, as it is not possible to obtain with them the various forms of waves in the ordinary distribution systems. The whole discussion is briefly reviewed editorially in that journal.

Effect of Wave-Form on the Alternating-Current Arc. FRITH. *Phil. Mag.*, June.—A reprint of the complete Physical Society paper, with the illustrations, which was abstracted in the *Digest*, May 23.

Experiments with the Jandus Arc Lamp. KOERTING and MATHIESEN. *Elek. Zeit.*, June 4.—A description of comparative experiments made with this lamp and with one of the usual type, the results of which do not agree with those in the tests of Houston and Kennelly; the results are unfavorable to the lamp; they measured the intensity of the illumination, as they claim that the intensity of the sources are in general of no great practical interest. In this lamp the light must pass through two globes; if the inner globe was made of clear glass and the outer one of alabaster glass, the results for the same size of globe would have been practically the same, but in this case the inner one is made of alabaster glass, for very good reasons; the light is more diffused than in the usual lamps, but notwithstanding the efficiency of illumination is lower on account of the nature of the long arc; when such a long arc, of 70 to 80 volts, is produced in a small enclosed globe to which little air has access, the ends of the carbons become quite flat, and the area of the upper carbon is so great that the arc cannot cover it, and therefore moves around continuously, the light therefore shifting in various directions, which would be very objectionable were it not for the diffusion; the color of the light is also different from that of the usual arc, as there is much violet light in it, which is useless for illumination. The results of their measurements are given, the Jandus lamp being run with 100 volts, of which about 30 were lost in the resistance; it consumed 5 amperes, or 500 watts; it was compared with a normal lamp of 9.1 amperes, two of which were connected in series across 110 volts; the Jandus lamp was run first with the carbons belonging to it and then with a cored positive carbon; with the latter the flickering was somewhat reduced, but the wandering of the arc remained the same; the measurements of the illumination were made at seven different points on the wall of the room, for each of the two lamps; calling the illumination from the ordinary lamp 100 per cent., that from the Jandus lamp in one case was 63 per cent., in another 56, in another 73, in another 58.5, and in another 46.5; the illumination from the ordinary arc was nearly constant, while from the Jandus lamp it varied; in the latter the illumination diminished with the time, which was due to the gray deposit in the inner globe; for outside illumination the results would be less favorable, as the reflection from the ceiling would be lost. A calculation is made of the economy, showing that for this lamp there would be a saving of about $5.5 for a thousand hours, in the carbons, while the cost of the increased energy would be about $19.3. They therefore conclude that there is little competition between the two; the lamp would take a place between the arc and incandescent lamps, if the wandering of the arc could be prevented, but it is not thought likely that this can be accomplished; with alternating currents, negative results were obtained, as it was not possible to maintain an arc of such length.

Pilsen Arc Lamp. *L'Elec.*, June 6.—A well-illustrated description of this lamp as made in France; the principle is based on the use of cone-shaped movable cores in solenoids, one of which is a series and the other a shunt coil; it is extremely simple, having no gear wheels; it is a differential lamp with a fixed position of the arc.

Sussmann Miners' Lamp. *Eng. & Min. Jour.*, June 13.—This lamp has recently beeen introduced in England and has given very satisfactory results; the novelty consists in the accumulator used; India rubber and powdered pumice stone are incorporated with the active material, this being claimed to make the active material adhere more firmly to the plate, and give it greater porosity; a solid electrolyte of small resistance is used, and is made by adding finely powdered and dried cellulose to sulphuric acid, making a thick paste; the lamp measures 2.75 inches square by 8 inches high and weighs 3.5 pounds; it will store about 7 ampere-hours at 6 volts; the average current during discharge is 0.53 amperes and the variations in volts toward the end is less than 5 per cent.; it will thus give a light for 10 hours.

POWER AND HEAT.

Utilization of Small Water-Powers. STEIGER. Lond. *Elec.* and *Elec. Eng.*, June 5; conclusion of his paper (see *Digest*, last week), including the discussion; it is also being reprinted in the Lond. *Elec. Rev.*, June 5.—He gives further illustrated descriptions of existing plants. Most of the plants described are for moderately high falls, the information concerning low falls being somewhat scant. The discussion refers almost entirely to the hydraulic engineering features; Mr. Carter thought the figures given for the low falls did not prove that such falls were useful for electrical purposes; Steiger in his reply emphatically contradicted the statement of Carter, that impulse turbines were suitable only for extremely high falls; an impulse turbine was suitable anywhere for a fall of three feet up to any number of thousands of feet, where it was constant and could be regulated according to quantity of water without loss of efficiency; it had been proved in more instances than those which he had given that a water fall varying from one to five or six feet could be used and the power obtained was satisfactory.

Chevres-Geneva Transmission Plant. *L'Eclairage Elec.*, May 30.—An illustrated description of the alternating-current water-power plant which has just been opened and which is one of the chief attractions at the national exposition in Geneva; owing to the great fluctuations in the water, two turbines are used on the same shaft, one over the other; the dynamos are of the vertical shaft type.

Horse-Power and Floor Space. *Cassier's Mag.*, June.—An editorial note calling attention to the fact that the concentration of power has probably been carried to a greater degree in the Duane Street station of the Edison Illuminating Company, of New York, than in any other; nearly 27,000 horse-power are developed, the floor space being at the rate of less than 2 horse-power per square foot.

Fresno Transmission Plant. LOW. *Jour. of El'ty*, April.—A long, well-illustrated description of this plant which is operated at a higher head of water, nearly 600 pounds, than any other electrical transmission plant in the world.

TRACTION.

Electric Railway System for Berlin. KALLMANN. *Elek. Zeit.*, June 5.—A reprint in full of a long paper recently read before the German Society of Electricians; it is general in character, discussing the advisability of a general municipal plant, which he favors, and comparing the different systems; it is largely of local interest. He seems to favor a combined accumulator and trolley system, in which the accumulators are to be used for portions of the city where overhead wires would not be allowed, while the overhead system is used in the outlying portions, the accumulators being charged while the cars are used on the trolley system; he shows that the weight of accumulators required would be much less than in the usual accumulator system, while other advantages would also be gained; he thinks the difficulties involved in such a composite system can be overcome. He discusses briefly the question of costs of the different systems, which is followed by a discussion of the safety devices and of the return circuit.

Polyphase Mountain Railway up the Gornergrat, at Zermatt. Lond. *Elec.*, June 5.—A note stating that it has been decided to use the polyphase system on this road, similar to the one used at Lugano; the well-known firm of Brown, Boveri & Co. will furnish the whole equipment. (As these are the same parties who constructed the experimental line at Lugano, it may be taken as an indication that the polyphase system is a success on that line.)

Dublin. Lond. *Elec. Rev.*, June 5.—A long, well-illustrated description of the electric railway of that city, the distinguishing feature of which is that the current is transmitted from the power-house in the form of a three-phase current, to the various points of the line where it is converted into 500-volt continuous currents; the system is in many respects similar to that at Folsom-Sacramento. An illustrated description is also given in the London *Engineering*, June 5.

Development of Electric Traction Apparatus in the United States. Parshall. Lond. *Elec.*, June 5.—A long abstract of a Society of Arts paper read Feb. 18.

Ascending Grades. Foster. *St. Ry. Jour.*, June; a reprint of a paper read before the California Street Railway Association.—He discusses in general the ascending of grades and gives brief descriptions of a number of devices used in the Pacific Coast cities where there are very steep grades. There is a misconception as to the power required by an electric car on a grade, as the speed does not remain the same on the grade as on the level; as the work to be done increases the car speed decreases until the power is within the limits of the motors; diagrams are given showing how the speed decreases up to 14.5 per cent. grades, as also a curve showing what the power would be if the speed remained constant. The motormen are usually instructed to use only the series notch on heavy grades, as it is more economical to run the motors in series than in multiple; this question he discusses and finds that from the standpoint of the repair shop the series combination is the cheaper; from the standpoint of the power-house engineer it is also better, as the plant can handle twice as many cars than if they were run on the multiple notch; from the standpoint of the investor the series notch is also preferable for grades, as the station capacity would have to be doubled; but from the standpoint of the watt per car-mile, or the coal pile, the multiple notch is found to be slightly cheaper; the current will be more when in multiple but the time will be less than in an inverse ratio to the current, or in other words the speed will be more than in a direct ratio to the current; this saving, however, is not worth considering, as it is undoubtedly more than counterbalanced by the disadvantages; theory states that the amount of "power" (he evidently means work or energy as distinguished from power) required to propel a car up a grade is independent of the speed, for, with greater speeds the time during which it is exerted is shorter; but there is a disagreement between theory and facts, owing to the relative car efficiencies at the two notches, it being higher at the multiple notch. It is often asked what the steepest grade is that can be ascended, a question not easily answered; he shows, however, what grades have been climbed, and states that it is not so much a question as to how steep a grade can be climbed, as how steep a one can be safely descended; in San Francisco grades of 14.54 per cent. are operated successfully in both directions, and at Oakland 14.25 per cent.; in Seattle a single truck car climbed a grade of 16.85 per cent., 500 feet long, but the car was not allowed to descend it without an outside check on its speed; if the car is brought practically to a stop at the top of a grade and then let down at six or eight miles an hour, the danger of a runaway or flattened wheels is very slight; some motormen use a method which allows them to descend rapidly with the brakes on, and yet not slide the wheels; this is done by putting the controller on the series notch while the brakes are set; the maximum braking effect is when the pressure is just under the skidding point; but the idea of using power while descending grades is the reverse of what engineers seek to realize; it may be argued that a car can be stopped more quickly by causing sliding wheels to rotate than by letting them slide; in a test it was found that the pull per ton required to tow a car with the brakes set decreases from 42 to 5 pounds as soon as the wheels slipped; it would be much cheaper however to allow the wheels to turn by slacking of the brakes than to do it by using the current. At Mt. Lowe two cars are permanently attached to the opposite ends of a cable that passes around a winding drum at the top of a grade, and the force of the descending car aids the ascending one; on Fillmore Street, in San Francisco, there is practically a double track and the descending car aids the ascending one as at Mt. Lowe, but the difference between the loads is made up by the use of motors; at Seattle there is a single track with a second one below it in a conduit; the descending car pulls up a load of pig iron as a counterbalance below, until it reaches a level track above; the next ascending car pulls the endless cable and thus starts the counterbalance down the grade.

Sectional Contact System. Elec. Ry. Gaz., June 10.—A brief description taken from a patent specifications, of the Johnston-Lundell system. There are a series of contact blocks between the rails, alternately near one rail and the other; the contact is made with them by two bars carried on the bottom of the car and long enough to reach two contacts; the first impulse of the current is taken from a storage battery carried by the car, the current being sufficient to drive the car over crossings, or in the event of a possible failure of the contact; the principal use of the battery is to start the contact switches, and it does this by sending a current through the magnets, of which there is one with each pair of contacts, which operate the necessary switches; the battery becomes charged from the line current while the car is in motion; the car can pass equally well in either direction. A suggestion is added that an insulated return might be used instead of a track return without complicating the contact arrangements; this would interfere with one of the features, but it is thought to be a question whether it would not be outweighed by the advantages of an insulated return. In an alternative form the battery current passes merely through the magnets and not through the motor, and it is intended to use this for heavy railway work.

Car and Line Tests. Pond and Curtiss *Sibley Jour.*, May.—An abstract from a thesis describing the tests on the Buffalo & Niagara Falls railway. They were divided into four parts, the cars being tested for friction, traction, acceleration and a general electrical test determining the requirements of the car and individual motors; the cars without a load weighed 22,000 pounds; the friction was determined by starting the car and then allowing it to run until it came to rest under the force of the friction, and from the data obtained the friction was calculated; the results obtained agreed very closely with the traction tests made in the usual manner. The results refer to a car without a load, and are as follows: Friction of car on a straight level, 208.5 pounds; traction coefficient on a straight level, 6.86 pounds per 1000; acceleration from zero to full speed, 16.03 horse-power; average current over entire line, 63.4 amperes; average electrical horse-power of car over entire line, 40.44; average speed, 23 miles per hour; maximum on regular run, 36; maximum attained, 42; maximum current taken by car, 188 amperes; maximum electric horse-power of car during test, 143.

Test of Power Plant at North Tonawanda. Hasbrouck, Benton, Smith and Austin. *Sibley Jour.*, May.—Results of tests of boilers and engines of the plant of the Buffalo & Niagara Falls Railway.

Trolley Line Without Poles. Sc. Amer., June 20.—In the city of Chemnitz, Saxony, no trolley poles are used, but the span wires are held to hooks which are firmly fastened on to the walls of houses and are tested with seven times the weight they will be called upon to bear; owners of houses without exception preferred to allow the use of their houses free rather than have the poles on the sidewalks; the hooks are made in the form of ornamental rosettes. The increase in traffic since the introduction of electricity has been 60 per cent.; there is no conductor, as it was calculated that 450,000 evasions in the fare would be required to offset the saving in dispensing with the conductor's salaries.

Stringing Trolley Wire. Elec. Ry. Gaz., June 10.—A simple and rapid system, devised by Walker, and used on the Sioux City line; the reel containing the wire is placed on the front platform so that it may revolve and put a tension on the wire; from here the wire passes over a wheel on the roof, where the men standing on the platform can readily attach it to the supports; the wire is live and the current for propelling the car passes through it; by this means it is possible to string the wire at the rate of about a mile a day, which is much more rapid than by the other systems; it is expected to use this system on all the lines hereafter.

Locomotive for the Elevated Railways of New York. Eng. News, June 18.—The Westinghouse electric locomotive is to be examined by the officers of the New York elevated railways with a view to having trials made; the engine resembles a street car mounted on four-wheel trucks, each truck having two Tesla polyphase motors.

Conduit Railway. Eng. News, June 1.—The General Electric Company proposes constructing a conduit road on Wentworth Avenue, Chicago, on the basis of a somewhat liberal proposition, which was made in opposition to a proposed trolley line.

Dublin-Dalkey. Elec. Ry. Gaz., June 10.—The first part of a well-illustrated description of this railway, in which polyphase currents are used to transmit the power which is locally transformed into a direct railway current.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Revenue Accounts of Central Stations. Lond. *Elec. Eng.*, June 5.—Abstracts of the accounts and balance sheets of the Stafford, the Tunbridge Wells and the Nelson Corporations.

Economical Generation of Power in Central Stations. Field. *Sibley Jour.*, May; an abstract of a recent lecture delivered at Sibley College.—It is only recently that good engineering work has been done in the design and construction of central stations; he shows how the conditions have gradually changed, and that the design of a station is largely a matter of mechanical engineering, only a small part being electrical; dynamos are built up to 1200 kilowatts for direct-current incandescent and power work, also for 150 arc lights; compound and triple-expansion engines are now used almost entirely, either condensing or non-condensing, the compound having proved itself the best for railway work; for large work some form of water-tube boiler is generally used; for direct-current railway work the limit of economical distribution is seven to eight miles, or more usually five to six miles, the trolley wire being connected to feeders in half-mile sections; storage batteries can now be had which are guaranteed to give good service, and there is a large field for

them; generators are generally direct-connected, and the units are all made of the same size, except when they are very large, when a small one is added to the plant; they should never be run at less than 40 per cent of their normal load. He gives the costs in detail of a railway power plant of 1350 horse-power; also the detailed record of the average monthly expenses for such a road, showing a total cost per car mile of 1.1 cents; another station showed a record of 500 to 650 watt-hours per engine horse-power and a coal consumption of 0.365 pound per kilowatt-hour; he gives a table comparing the operating expenses of a lighting and a railway station, showing the relative costs of running the two plants; in the former the total cost of generating power was 1.342 cents per kilowatt-hour, while for the railway plant it was 0.9 cent.

Current Supply from Central Stations. LIEB. *Cassier's Mag.*, June; a brief summary of a recent paper.—He divides the subject into the generation and the distribution, showing that it is largely a question of mechanical rather than electrical engineering; he points out the loss due to the inefficiency of the apparatus for converting the heat energy into dynamic energy as compared with that in the electrical apparatus; he thinks that as the size of stations increases the ratio of the maximum load to the total will continue to fall; although motor service is advantageous it is by no means ideal as the loads overlap; the ideal service for leveling the load curve should cease at the time of maximum lighting, and he hopes that some application may appear in the many uses for electric current which would meet this ideal.

Charging for Electric Current. LEWIS. *Elec. Eng.*, June 17; an article replying to one of Farnsworth abstracted in the *Digest*, June 13.—He differs with that writer in that this system would be an improvement over the kilowatt-hour charge, taking general business principles into consideration; he argues that the fixed charges are no more entitled to be guaranteed by the customers than those of a dry goods house; the idea would be a good one if the company was a mutual co-operative one, in which each user becomes an interested stockholder; that the consumer should guarantee the fixed charges, pay for the commodity and see the promoter pocket the profits, is much like "heads I win, tails you lose"; the basis of charging for any article of commerce is a certain price per unit and the electrical current does not differ in its distribution from anything else; until the electric current is sold on the co-operative plan the investigator must trust to careful management to find profit in the business, taking equal chances with other investors; to make Farnsworth's plan equitable and fair to the customers, frequent statements showing the proportions of fixed charges would have to be made.

Norwich. Elec. Eng., June 17.—An abstract, with some of the illustrations, of the descriptive article noticed in the *Digest*, June 20.

ELECTRO-PHYSICS AND MAGNETISM.

Röntgen-Ray Experiments. LODGE. Lond. *Elec.*, June 5.—A short article giving the results of some experiments made with a tube having three terminals, two of which are aluminum cups facing each other, and the other a platinum disc half way between them, inclined at an angle of 45 degrees, its terminal coming out at right angles to the other two; the results are as follows: When the cups were anode and cathode respectively, the platinum disc acted as a moderately weak source, chiefly on the side facing the cathode; when the platinum is connected to the cathode its emitting power ceases; when connected to the anode it becomes a much more powerful source; connecting it to the anode through a Wimshurst machine, which charges it positively, it acted as a strong source, but when the machine was reversed it was a very feeble source; short-circuiting the Wimshurst machine, thus making the disc the anode, sometimes improves and sometimes enfeebles the action; with a low vacuum the action is best without the machine, but with a high vacuum the machine greatly improves matters; the continuous discharge may be said to maintain a supply of dissociated atoms able to convey the current, thus dispensing with the heating otherwise frequently necessary; if the machine is interposed between the disc and cathode it does good only when it maintains a positive charge on the platinum; without the machine the action is best when one cup is the cathode and the platinum disc the only anode, so that the charge is concentrated on it; the addition of the machine between the disc and the other cup strengthens the action still further; it is desirable to maintain a positive potential of the disc in every way; the usual hasty hook mode of connection for low-vacuum tubes is unsuitable for those of high vacuum; when the coil is connected to the two cups the disc becomes charged so as to emit sparks to a wire connected to it, this charge being always positive, the effect being that the disc requires the positive charge which appears necessary and is certainly advantageous to its action as an X-ray source. He stated that according to Lafay X-rays are deflected by a magnet, if they are passed through an electrified plate, as if they were flying particles, which after being electrified can be magnetically deflected; this is profoundly important if true, but Lodge fails to find it true; experiments on magnetic deflection are liable to disturbances owing to the action of the magnet on the cathode rays in even a distant bulb; he therefore experimented with the twisting of rays traveling along the lines of magnetic force; the portion of the article describing these experiments was abstracted quite fully in THE ELECTRICAL WORLD, June 20, page 735.

Stereoscopic Röntgen-Ray Images. MACH. *Zeit. f. Elek.*, June 1.—A reprint of a short paper which appeared in *The Monist*, April. The object is placed on the cover of the plate and an impression is taken; the plate is then changed for a new one without altering the position of the object and the tube is slightly moved, after which a second impression is taken; the two impressions may then be combined stereoscopically. He also tried to combine two images on the fluorescent screen, directly by means of the stereoscope, the two images being projected from two different points (the details are not described). The experiment has failed on account of the dimness of the image even at short distances; it would not be impossible, however, to overcome this by increasing the intensity of the rays; it would then be possible for a surgeon by direct stereoscopic inspection to see at the same time the object and the instrument in their correct positions. He states that it is difficult to decide whether the rays are longitudinal light as long as the absence of polarization has not been proved; owing to the absence of appreciable refraction and reflection, polarization is hardly to be expected; the rays cannot be isolated impulses; they must be periodic and of short wave-length as otherwise no sharp shadows could be obtained; some of the results might be explained by assuming a composition of rays of different wave-lengths; the strong absorption of short ultra-violet light even through thin layers of air is against the assumption that the rays are ultra-violet light.

Phosphorescence and X-Rays. CAMPANILE and STROMEI. Lond. *Elec. Rev.*, June 5.—Some months ago they showed that a spark introduced into the circuit of a coil and a Crookes tube modifies the action of the rays; a positive air spark is a spark which is introduced between the positive pole and the tube; they found that a positive air spark increases the effect of the X-rays and a negative spark diminishes it; they produced the Crookes phenomena and the X-rays from Geissler tubes; the following arrangement gives the best results: two pieces of tinfoil are secured to the outside of a Geissler tube and are connected to two poles of an induction coil; the Geissler tube is transformed momentarily into a Crookes tube while it maintains the properties of low-vacuum tubes; in this arrangement the phosphorescence and the X-ray effect depend on the length of the air spark.

Röntgen-Ray Tubes. Elek. Zeit., June 4.—An illustration of the tube made by the General Electric Company, of Germany; it is spherical, has an inclined platinum disc at the centre and two concave electrodes at either side, either of which may be used as a cathode. With the aid of fluorescent screens, it is stated that the exposure of photographic plates may be reduced 10 to 100 fold; with one of these tubes and a 20-cm induction coil the ribs, spine, the heart and its action, as also that of the lungs, of a young man, can be seen on a fluorescent screen.

Use of Non-Uniform Magnetic Fields in Connection with Radiographs. MESLIN. *L'Eclairage Elec.*, May 30.—A reprint of the article noticed in the *Digest*, May 9.

Theory of X-Rays. SHETTLE. Lond. *Elec. Eng.*, June 5.—He offers a theory as to the cause of the phenomena produced by Röntgen rays, in connection with a theory which he published in 1894 as to "the formation of matter and the nature of the ether," by the acceptance of which "all mystery will vanish"; the explanation is not quite clear, but he seems to assume that "the force passing through the Röntgen tubes" gives "a definite polar arrangement to the atoms of all surrounding matter, which polarity is more especially in the direction of the force."

Cathode Rays and Continuous Discharges Through Gases. LEHMANN. *L'Eclairage Elec.*, May 22.—Translation in abstract from the *Wied. Ann.*, Vol 56, page 304.

Transparency of Filaments. CASSELS. Lond. *Elec.*, June 5; a reply to the recent criticism of Allingham (see *Digest*, June 6; also June 13).—He states that the fact that a filament casts a shadow of itself does not invalidate the suggestions which he made; a piece of opaque glass, for instance, will transmit light, yet at the same time will cast a shadow, while it would not be called transparent; it is possible that the carbon at incandescence is a transmitter of actinic or chemical rays only; it may not be a transmitter of light at all, the effect shown in the photograph being possibly due to other causes.

Electrical Trevelyan Rocker. APPLEYARD. Lond. *Elec.*, June 5.—Referring to Vaughton's description (see *Digest*, last week) he states that such a rocking device was described and published in 1890; he furthermore claims that the buzzing in telephones is frequently due to a Trevelyan effect on the loose carbons of the transmitter, and he thinks it is not likely that the hissing of the arcs may be associated with the same action.

Simple Method of Analyzing Periodic Curves. WEDMORE. Lond. *Elec. Eng.*, June 5.—A reprint with illustrations of the article noticed in the *Digest*, May 9.

Electromagnetic Theory of Moving Charges. MORTON. *Phil. Mag.*, June.—A reprint of a short mathematical Physical Society paper.

Computations of Coil Windings. SLINGO and BROOKER. Lond. *Elec. Rev.*, June 5.—They claim that the matter of computations for determining the number of turns in coils of different spaces is more of interest to the amateur than to the professional designer, as the latter generally ignores such formula and works by rule of thumb; although the subject

is therefore not as important as it might at first appear, they give a review of the various points involved, and criticise unfavorably a recent article by Baker (see *Digest*, March 21); they applied his formula in practice and found it very incorrect; more startling results were obtained with another formula; they did not approve of the method of forcing the calipers on the insulated wire, and state that the diameter of such wire may be more accurately determined by winding a length of it on a cylindrical rod close together and measuring the space occupied, which, divided by the number of wires, will at once give the outside diameter; another cause of error in Baker's article is the assumption that when evenly wound, the wire, in one layer, falls into the grooves between the adjacent convolutions of the layer below, thus increasing the quantity of wire which can be wound in a given space; they show that when a coil is wound in the usual way the convolutions are crossed by the wire, thus occupying just as much space as though it were square in section, the size of the square being equal to the diameter of the wire; they have shown by repeated trials that this is the case; they develop simple formulas for the winding; the article is to be continued.

Hysteresis of Iron in a Revolving Field. Fleming. Lond. *Elec.*, June 5.—A note mentioning that certain experiments have recently been made with the aid of a revolving electromagnet, for examining iron; a very thin circular horizontal disc of iron or steel suspended on a torsion wire revolving in a magnetic field, was used to measure the relative values of the hysteresis for various inductions; he gives the curves showing the results, which confirm Bailey's discovery that beyond a certain value of the induction the hysteresis loss in iron in a revolving field is diminished; by using very thin discs the induction can be carried up to high values; the effect of eddy currents can be eliminated by making experiments at various speeds of the magnet; the curve shows clearly that beyond a certain value of the induction the hysteresis loss falls off very rapidly; a fuller description of the experiments is promised.

The Action of Iron in Dynamos. Potier. *L'Elec.*, June 6.—A reprint of a brief Academy paper replying to and criticising unfavorably the theories in the recent paper by Deprez (see *Digest*, last week); he shows that the observations cited by Deprez are not in contradiction to the accepted rules regarding the E. M. F. induced by the variation of the flux enclosed by the circuit, but on the contrary that they confirm these rules.

Crookes Tubes. Hutchins and Robinson. *Am. Jour. of Sc.*, June.—They describe how tubes may be readily constructed within an hour's time; hard German glass or other glass free from lead has proved best; it is rarely free from bubbles which are the cause of destruction of many tubes; it is difficult to insert the electrodes and it may therefore be necessary to use three kinds of glass, soft lead glass for the seal and a piece of soft glass for connecting this to the tube; the ordinary spherical form is not the best; they have found that a simple straight tube 0.5 to 1 inch in diameter having a small and very thin bulb for the cathode window has given the best results; it may be 4.8 inches long; the anode crosses the tube just above the bulb; platinum foil is best used for the anode, being inclined about 45 degrees to the cathode ray; a concaved plate is the best for the cathode; they have not come to any conclusion as to the best size of it; when the anode was an aluminum disc parallel to the cathode and nearly large enough to close the tube, it presented little or no interference with the X-rays; they think that such tubes are more effective than the usual ones; some hints are given regarding the pumping which should not take more than 20 or 30 minutes for a moderately sized tube; when the tube is cool the exhaustion is complete if short sparks can be drawn from the bulb and if there is little or nothing to be seen in it except green light; there is danger of carrying the exhaustion too far, as the vacuum increases during the first hour of the use of the tube.

Researches with Röntgen Rays. Mayer. *Amer. Jr. of Sc.*, June.—He shows that the rays cannot be polarized by passing through herapathite; he discusses the subject of a formula for the transmission of the rays through various substances; in this he assumes that the rays are homogeneous, but thinks it very likely that it will be shown that they are not; in the apparatus for measuring the permeability of various substances he uses the wire netting device of Rood; it is laid over the sensitive plate over which the materials to be examined are to be placed; this he uses to give the data for the constants of his formula; on the wire netting he cements piles of glass discs each glass being 0.1 mm thick, the pile gradually increasing in thickness, thus forming a graduated series of thicknesses through which the rays are made to pass, the image of the netting on the photographic plate being taken as an indication of the intensity of the rays transmitted; the formulas for several substances are discussed and some figures are given. He shows that the actinic effect of the rays varies inversely as to the square of the distances of the plate from the source; from this it follows that the actinic power is not sensibly absorbed in traversing the air and also that these rays are not sensibly diffused by radiation from the molecules of the air at ordinary pressure; these deductions are at variance with the facts observed by Pupin with fluorescent screens, but not with the actinic effects. In his experiments the source of the rays was a calcined shell supported by the anode wire and placed opposite the cathode; the walls of the tube he finds furnish a small percentage of the rays, but not enough to make their presence known in pin-hole photographs.

Recent Work with Röntgen Rays. Am. Jour. of Sc., June; abstracted from *Nature*, April 30.—Winklemann and Strauble used prisms of various metals and obtained in each case a refractive index of about 0:0.0038 referred to air; Rhigi, Fontana and Urnani find that the radiations from a Crookes tube do not affect the radiometer in any way; Doelter finds that the opacity of all minerals does not always increase with the density, although minerals having a specific gravity greater than 5 are relatively opaque; the complexity of their chemical constitution affects the opacity, but by no general law; dimorphous minerals show only slight differences; in most crystals the absorption does not depend on the direction of the rays; all minerals naturally fall into about eight well defined groups; the diamond is 10 times as transparent as corundum and 200 times as transparent as tinfoil.

Absorption of Röntgen Rays by Chemical Compounds. Novak and Sulc. *Am. Jour. of Sc.*, June; abstracted briefly from a German chemical journal.—They examined nearly 300 substances; they conclude that the absorption has no relation to the molecular weight or the arrangement of the atoms; they found an indication of the influence of elements of varying atomic weight; the results of a certain series agree in a striking manner with the order of the weights of the atoms, and the metallic or non-metallic character of the substances seems to be without influence; another experiment showed the influence of almost identical atomic weights; with compound radicals it seems as though the absorptive power depended on the average atomic weights of the component atoms.

Röntgen-Ray Picture of the Chest and Shoulder. Morton. *Elec. Eng.*, June 17.—A reproduction of a negative; he states that in some of his negatives the heart and liver are shown, as well as outlines of tumors in the brain; he has also obtained an excellent picture of the adult pelvis and thighs.

Colardeau's X-Ray Tube. Elec. Eng., June 17.—An illustration of the tube described in the *Digest*, May 23.

ELECTRO-CHEMISTRY AND BATTERIES.

New Electrolyzer. Tommasi. *L'Elec.*, June 6; a reprint of a short Academy paper.—There is one cathode between two anodes, and it is mounted so that it can be rotated; the part above the liquid passes between two scrapers, which take off any spongy deposit and depolarize the surface of the disc; he claims a considerable increase in economy due to the diminution of the resistance, as it is possible to bring the electrodes much closer together, and the densities of the layers of the liquid traversed by the current are always the same.

Calculations of the Conductivity of Mixtures of Electrolytes Having a Common Ion. McIntosh. *Phil. Mag.*, June.—A reprint of a recent paper in which he gives the results of observations and calculations made according to the suggestions of MacGregor, to determine the differences between the observed and calculated values in mixtures of sodium and potassium chloride solutions of greater strength than those examined by Bender, and to show how these values are related in certain cases.

Small Electric Light Battery. L'Elec., May 30.—A brief, illustrated description of a small battery having a light attached, which is operated by tilting the battery; the positive pole is a cylinder of thin platinum and the other a rod of unamalgamated zinc; several cells are connected in series.

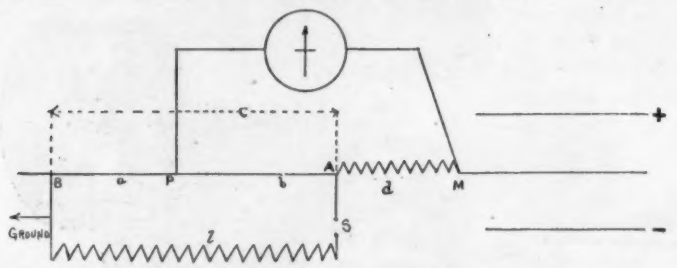
Electrolysis of Chlorides. Andreoli. *Eng. & Min. Jour.*, June 13.—The first part of an article in which he intends to describe the processes which have been successfully worked on a commercial scale. He points out the difficulties which were encountered, chiefly in obtaining a suitable diaphragm; ordinary retort carbon is the most satisfactory material for the anode, it being first filled with paraffine and then heated to a high temperature. He discusses the Richardson & Holland process, which is being worked successfully in England, and is said to have a capacity of 60 tons of soda and 33 of chloride, which proportion, however, he states is not correct, showing a mistake in the data; he describes briefly the Castner-Kellner process, for which great claims are made; an installation of 4000 horse-power is to be erected, capable of turning out daily 18.5 tons of silver and 40 tons of lime.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Method of Determining Dielectric Constants. Nernst. *L'Eclairage Elec.*, May 23.—To determine these constants, the capacity of condensers are compared, in which the plates are made of the material to be examined; he endeavored to eliminate the influence of the conductivity and describes a method which he found satisfactory; he produces artificial leakage by a resistance and finds that under certain conditions there is a mimimum value, which enables one to determine the relations; the details of the apparatus are described and the apparatus illustrated.

Determining Dielectric Constants. Smale. *L'Eclairage Elec.*, May 20; a translation in abstract from the *Wied. Ann.*, Vol. 57, page 215.—A description of a modification by the author of the electrometric method; an insulated needle is suspended unsymmetrically between the two electrodes which are charged; for the same difference of potential between the electrodes the deflections are proportional to the dielectric constant of the medium.

Localization of Faults in Electric Light Mains. RAPHAEL. Lond. *Elec.*, June 5; a continuation of his serial (see *Digest*, June 6).—He describes the Wheatstone bridge method shown in the adjoining cut; *d* is a coil of known resistance, the results being most accurate when this resistance is about equal to the insulation resistance, as the sliding contact *P* on the slide wire resistance *AB* will then be near the middle; *l* represents a few lamps in a parallel; the galvanometer should be fairly sensitive; the position of the sliding contact *P* is then adjusted until the same current



flows through the galvanometer whether the switch at *S* is open or closed; the resistance of the fault will then be equal to *d* multiplied by *a* and divided by *b*. There are certain advantages in using two sliding contacts for localizing faults, in which case the contact *B* is a movable one and the other the fixed one; *P* is then fixed at the reading equal to *d*, (or 10 or $\frac{1}{10}$ times this) and the sliding contact *B* is moved until balance is indicated by the two deflections being equal; then *a* will give the insulation resistance on the same scale as that on which *b* represents *d*; this modification is of advantage only when it is to be used frequently to test the same resistance. It may occur that the faults on the two outside wires make the potential of the middle wire zero, so that there will be no current through the bridge; in that case the point *M* might be connected to another main instead of the middle wire, as theoretically the bridge might be connected to any point of the network; in practice, however, it is preferable to leave it connected to the middle bar and to insert a few battery cells in series with *l*; if the current through the galvanometer is too great it should be shunted. He then gives a general comparison of the four methods which he has described; it is always advantageous in all of them to use a high-resistance recording voltmeter permanently connected with one or each of the outer mains and the earth; this shows which of the mains is faulty and acts as a sort of check on the insulation test; of the four methods the one just described is undoubtedly the most accurate, but it has the disadvantage of giving no indication of the relative fault resistances of the mains; there is always some uncertainty as to whether the fault is on the middle or outer wire; in most cases the third method (the modified voltmeter or ammeter method, in which the instrument is shunted by a resistance equal to its own, see *Digest*, June 6), is the one to be recommended; it is not quite as sensitive as the first, but has the advantages of practically earthing the middle wire only and of requiring an instrument of a much shorter range; when the fault resistances are so balanced that no current is obtained between the middle wire and the earth, it is perhaps preferable to use the first method than to complicate the third by the introduction of an artificial fault. In all the methods the insulation resistance obtained is that of the entire network, plants, switchboard, etc., in parallel; it is always advisable to insert fuses between the mains and the instruments; the four methods described are not suitable for alternating-current networks, although the fourth (bridge) may be used if the galvanometer does not deflect for alternating-currents, by putting a few cells of the battery in the arm *l*.

Ratio Between the Electrostatic and the Electromagnetic Units. HURMUZESCU. *L'Elec.*, May 30.—A reprint of a short Physical Society paper giving the results of a new determination of this ratio by the method suggested by Maxwell, modified so as to make it more accurate; the various results agreed very closely with each other and give a value between 3.0005 and 3.0020.

Universal Wattmeter. *L'Eclairage Elec.*, May 30.—An illustrated description of the instrument devised by BLONDEL and LABOUR, one of the chief features of which is the aperiodicity; it resembles the usual two forms of instrument, with a counterbalancing spring reducing the deflection to zero; there are two stationary coils, which produce a uniform field and may be variously connected; in the lower part of the instrument and attached to the moving coil frame there is a small cylinder of copper, which turns in the air space of an electromagnet, there being an iron core in the centre of the cylinder; the polar surfaces can be moved so as to increase the air gap, by means of which the damping may be regulated; the current for the electromagnet is obtained from accumulators.

Elementary Principles of Oscillating Instruments. ARMAGNAT. *L'Eclairage Elec.*, May 30.—A long article discussing the principles of measuring instruments in which deflections are produced; the present portion is a discussion of the subject in general, of the suspension, and the springs or torsion wires.

Aron Meter. *L'Eclairage Elec.*, May 23.—An illustrated description of the meter intended for accumulators which will register separately the currents in each direction; a description was noticed in the *Digest*, May 9.

Adjustment of the Kelvin Bridge. APPLEYARD. *Phil. Mag.*, June.—A reprint, with illustrations, of the short Physical Society paper, abstracted in the *Digest*, May 23.

Determination of a Unit of Light. MURPHY. *Jour. of El'ty*, April.—A brief, illustrated description of the Lummer & Kurlbaum unit (of the German Reichsanstalt); in this the light emitted is that from a square centimetre of platinum kept at a constant temperature and heated by an electric current, the temperature being defined by the relation of the amounts and its radiations under different conditions.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electrical Communication with Lighthouse and Light Vessels. Lond. *Elec.*, June 5; a reprint of the fourth report of the Royal Commission.—They describe the Danish system and the working of the cables at present in use on the English coast; in their conclusions they state that the present lighthouse cables work satisfactorily; the first was installed in 1893, since which time four more have been layed to outlying lighthouses; those to light vessels however, are not so satisfactory, but it is thought that the failures were due to remediable causes; experiments are being made on communicating by induction, the cable being run from the shore on the bottom of the sea in a circle under the light vessel, the vessel itself carrying a number of turns of insulated wire around its deck, the usual vibrating current being used; a call bell can be rung by a special arrangement; the system has not yet been subjected to a practical test at a light ship, but it is thought that it offered much greater chances of success than other inventions of the same nature.

Switchboard. SCHWENSKY. *Elek. Zeit.*, June 4.—A description, without illustrations, of the switchboard in the form of a table, which has been used satisfactorily by the German Government telephone department; the object was to combine the advantages of centralization without complicating too much the apparatus at the stations; as the prospects of doing this with vertical boards seemed hopeless, the horizontal form was used and found satisfactory.

Telephony in Finland. *Elek. Zeit.*, June 4.—A translation of a recent article, including a map of the circuits.

MISCELLANEOUS.

Resistance of the Human Body. MONMERQUE. *L'Eclairage Elec.*, May 23.—A short reprint from a recent work describing experiments made to compare the resistance of the human body for direct and for alternating currents; the results are given in the form of a full-page table. The electrodes were cylinders of copper having a surface of 49 sq. cm., about half which was in contact with the hand (presumably the two electrodes were held in the two hands, although no statement to that effect is made). The conclusions arrived at are, that for continuous currents the resistance varies between 3200 and 8000 ohms, according to the subject and the test; the sensation produced by the current is that of burning, which is greatest at the point of contact of the negative electrode; by raising the voltage gradually the subject can stand a more intense current and the resistance diminishes at the same time; 20 milliamperes can be endured; above about 70 volts this sensation is generally painful, and it is well to avoid contact with higher voltages; the hand in contact with the negative electrode had a tendency to stick to it even after the current had ceased to pass; if the current is stopped suddenly a tingling sensation is produced at the negative electrode, resembling that of an alternating current. For alternating currents the resistance of the body varies between 1500 and 5500 ohms, according to the subject and the test; the sensation produced is a tingling one; by gradually raising the voltage a greater current can be endured, while the resistance at the same time diminishes; a current of 20 milliamperes can be endured, but is very painful; from 15 volts up the sensation is generally painful and above 25 volts there is generally a contraction so that the subject can no longer let go of the electrodes; the effects of a current greater than 10 milliamperes persists during several days. In a comparison of the two currents he states that the alternating one is much more painful than the continuous; for equal voltages the resistance for continuous currents is much greater than for alternating, in the ratio of about two to four; the alternating currents are therefore the more dangerous, all other things being equal; with 200 volts and dry hands the current will be 13 or 115 milliamperes according as the current is continuous or alternating; in the latter case the periodic variations are between + 162 and — 162 milliamperes; with continuous currents a person can let go of the conductors, but with alternating currents there is a contraction which requires an external force to release the hold.

Electrotechnical Institute at Hanover. W. KOHLRAUSCH. *Elek. Zeit.*, June 4.—A long, illustrated description of this Institution of which he has charge.

Magnetic Concentration. *Eng. & Min. Jour.*, June 13.—A description with illustrations of the Wetherill system in which an extremely small power is said to be used and with which minerals may be separated which have heretofore been considered non-magnetic. With six amperes and 16 volts the machine removes franklinite from its mixture with willemite, the treatment requiring three passes each at the rate of 3.5

tons per hour; with 8 amperes and 22 volts three passes are necessary for hematite at the rate of 1.5 tons per hour. It is in use in South Bethlehem, where 1000 tons of ore per month are treated; a plant capable of handling 300 tons a day is in process of erection. The essential feature of this machine is that the magnetism is capable of delicate adjustment, thus admitting in many cases of separating products showing slight differences in magnetic permeability; it is also possible to fix the degree of concentration desired, and it may be worked for quality or quantity; the only substances in which iron is largely present that have not been attracted by magnets are the higher sulphides and the cyanides, but magnets are under construction with which it is expected to be able to separate these substances also.

Electrical Factory. MARTIN. *Elec. Eng.*, June 17.—A long, well-illustrated description of the factory of the Crocker-Wheeler Electric Company, at Ampere, together with illustrations of a number of their products.

Did Not Pay.

The affairs of the La Grange Automatic Telephone Company, La Grange, Ill., have been wound up, and the property belonging to it disposed of at a nominal price, reported to be just enough to cover the indebtedness of the company. It is stated that the company has lost money from the first and the investment which was made in it has proved a total loss, it having been found impossible at the rates charged and the number of telephones in use to pay the operating expenses of the company and keep the plant in order.

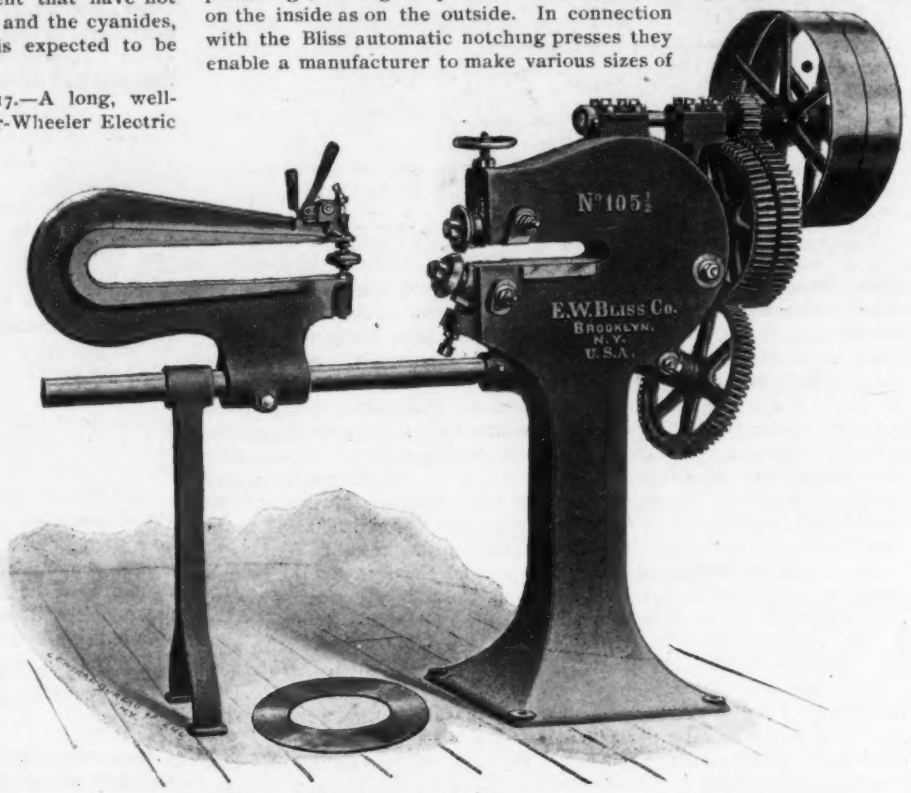
A Large Shipment of Electrical Apparatus.

The accompanying illustration represents a large shipment of electrical apparatus by the Westinghouse Electric & Manufacturing Company to Great Falls, Mont. It consists of eight loaded freight cars, the freight charges to its destination alone amounting to $8000. The machinery will be used by the Boston & Montana Consolidated Copper & Silver Mining Company in the refining of copper and silver. It is the largest works of its kind ever constructed for electrical refining purposes. The Boston & Montana Company is one of the largest mining concerns in the Northwest. Until a few years ago the entire copper production of that section of the country was sent East, some of it being refined in New England. Since the introduction of electricity in the refining process, the Western companies have been placed in a position to compete with the East. The Anaconda Mining Company some time ago purchased from the Westinghouse Company seven 360-hp generators, each having an output of 3600 amperes at 75 volts. Since the introduction of these machines the process of refining has proved a great success. The machinery of the Boston Company will be driven by turbines from the waters of Great Falls. The two generators will be directly connected each to a turbine. They are the largest ever made, being of 810 kilowatts, supplying 4500 amperes at 180 volts. These machines were shipped in four cars, while the other cars were filled with detail apparatus, such as switchboard appliances, etc.

TRAIN LOAD OF ELECTRICAL APPARATUS.

Shears for Circle Cutting.

Many makers of dynamos and motors require to use armature-core discs of various sizes, but not in sufficient quantity to justify the purchase of cutting dies for the plain rings and presses large enough to operate the larger sizes. The accompanying illustration represents one of the new models of circle shears made by the E. W. Bliss Company, Brooklyn, N. Y. The shears are used for cutting both the outside and inside of the plain rings, the angular position of the lower cutter giving as clean a cut on the inside as on the outside. In connection with the Bliss automatic notching presses they enable a manufacturer to make various sizes of armature discs with comparatively little outlay. They are also useful for any other work in which it is required to make circular rings or discs of sheet metal.



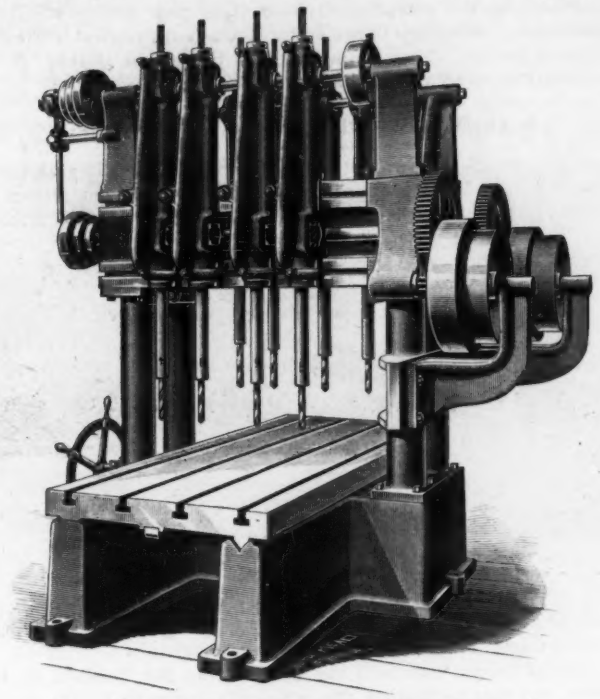
CIRCLE CUTTER.

This machine weighs 750 pounds, and is designed to cut circles of from 4 to 40 inches in diameter from metal not exceeding No. 16 B. W. G. If so required this shear is specially made to cut circles of larger diameter than 40 inches. A large machine is made to cut circles ranging from 14 to 72 inches from metal not heavier than No. 10 B. W. G.

Eight-Spindle Railway-Motor Drilling Machine.

During the past five years the competition in the manufacture of electric machinery has been very keen. One reduction after another has forced the manufacturers to invent and purchase the best of labor-saving machinery to allow a fair margin of profit on their production. Hardly any class of the appliances made has had so great a reduction in the selling price as the equipment for trolley cars. The Newton Machine Tool Works, Philadelphia, have been one of the first of the tool builders to appreciate the extensive market there would be for specially adapted machine tools for the manufacture of electric appliances. We illustrate one of their latest productions, which is a special eight-spindle drilling machine for drilling the eight holes for the cap bolts in the four bearings of a street-car motor. The machine has two rails that carry four spindles on each. The spindles can be adjusted from 5-inch centres to any desired distance to suit the different designs of motors. The operation of drilling the eight holes is both simple and ingenious. A motor frame is clamped to a jig at one end of the carriage, and while it is being drilled another motor is clamped to a corresponding jig at the other end, and when one motor is drilled the spindles are all raised together by power out of the holes, and the carriage is adjusted to bring the other motor in position to drill. By this method an almost continuous operation of drilling is performed. The spindles of the machine are driven with phosphor-bronze and Harveyized steel spiral gearing, have automatic feeds and

power, quick adjustment in both directions. As can be seen by the design of the machine, it is very heavy, and adapted for rapid drilling



EIGHT-SPINDLE DRILLING MACHINE.

through the steel castings, of which the motor frames are now constructed.

Large Turbines.

The Dayton Globe Iron Works Company, successors to Stout, Mills & Temple, Dayton, O., is shipping to the Boston & Montana Consolidated Copper & Silver Mining Company, Great Falls, Mont., what is said to be the largest and most powerful pair of horizontal turbines that have ever been turned out by any turbine builders in this country, to operate under the head they are designed for. These turbines are of the largest design thus far manufactured, being 57 inches in diameter, and under the average head at which they will work, will develop 3258 horsepower.

The turbines are placed on a cast-iron draft chest, and discharge centrally through a draft tube. They are surrounded by an iron flume 14 feet 6 inches in diameter, and 32 feet 6 inches long. The whole is mounted on double I-beams on each side 20 inches deep, 38 feet long, with four cross I-beams. The shaft is finished 10 inches in diameter, 42 feet 2 inches long, and is made of the best hammered iron. The weight of the shaft alone is over five tons. It is made in two sections. The coupling, which couples the sections together, weighs more than one ton.

There are stands outside of the flume at each end which support the shaft. Each of these stands weigh 8000 pounds, and are provided with babbitt-lined journal boxes, in which the shaft revolves.

The two turbines and outfits complete weigh 250,000 pounds, or 125 tons, and will require seven cars of nearly 20 tons each for their transportation. They are to operate two electric generators, one coupled directly to each end of the shaft, which will run from 144 to 160 revolutions per minute. The electric power will be used for smelting. The varying revolutions are required in order to increase or diminish the blast, as conditions may require.

The whole outfit is made of the best material and workmanship, and certainly does great credit to the engineering skill of the Dayton Globe Iron Works Company, showing, as it does, their ability to turn out this class of machinery on a mammouth scale.

Screw Pump.

The accompanying illustration (Fig. 1) represents a skeleton view of the internal mechanism of the Quimby screw pump, which is manufactured by William E. Quimby, New York City. It is simple in construction and efficient, besides being durable.

This pump is unique among pressure pumps in that it has no valves, no internal packing, and there is no pulsation in the delivery of the water or other liquid for which it may be employed to pump. From the fact that it has few moving parts it is evident that the cost for repairs and maintenance must be small, as is indeed the case. In construction there are four screws mounted in pairs on parallel shafts, acting as pistons in propelling the water. These screws are so arranged that in each pair the thread of one projects to the bottom of the space between the threads of the opposite screws, the pump cylinder closely fitting the perimeters of the intermeshing threads (Fig. 2). Inasmuch as the back pressure of the column of liquid is delivered against the screws in opposite directions there is no end thrust of the screws in their bearings. The suction connection at *S* opens into a chamber underneath the pump cylinder. The liquid as it is lifted passes through this chamber to the two opposite ends of the cylinder, from which points it is forced toward the centre of the same by the two pairs of intermeshing threads, the discharge being in the middle of the top of the cylinder, as shown in the illustration. The pump is driven by power applied directly to one of the shafts, the second shaft being driven by means of a pair of gears as shown. The action of the screws on the liquid pumped is continuous and the delivery is smooth and uniform. This pump is well adapted for direct-connected electric work, the pump and motor being mounted on the same bed-plate, as shown in Fig. 3. This arrangement reduces to a minimum the expense for repairs and maintenance and at the same time increases the efficiency of the apparatus. The small floor space required for this combination is one of its best features. This pump has been found to be very desirable in hydraulic elevator service. Where the elevator is operated by street pressure and the pressure fails or is unsteady, the service may be much

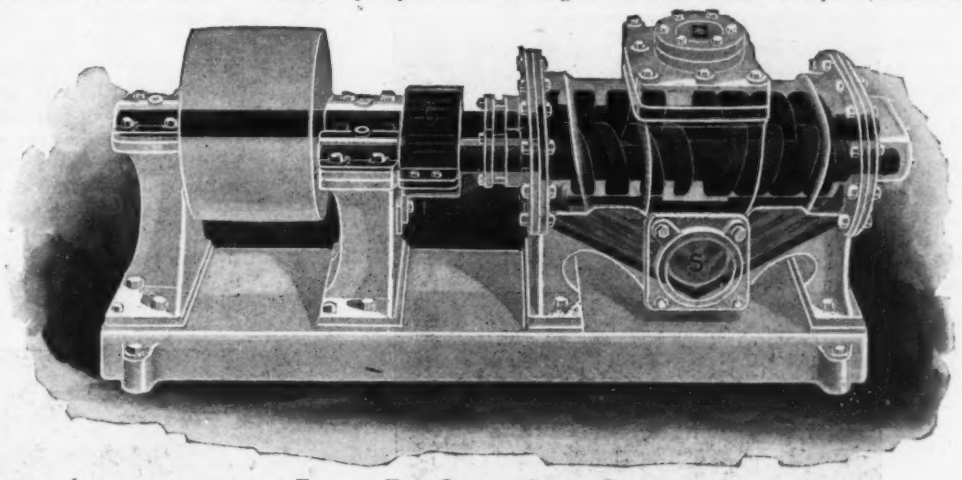


FIG. 1.—THE QUIMBY SCREW PUMP.

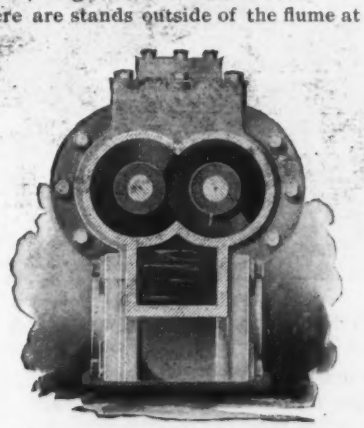


FIG. 2.—INTERMESHING THREADS.

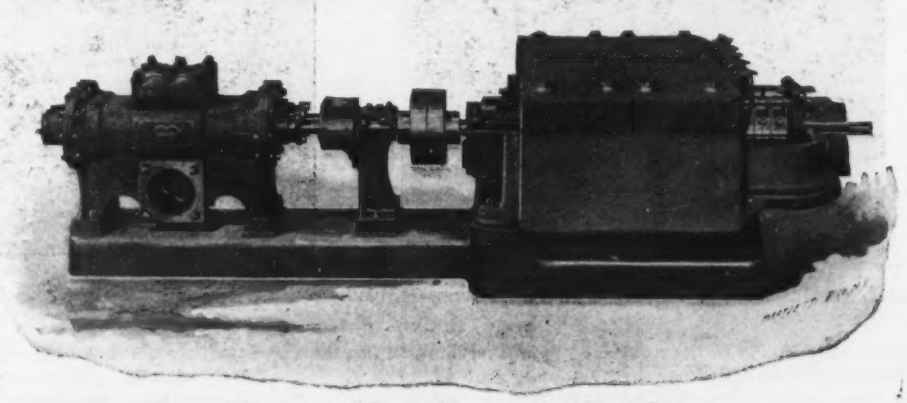


FIG. 3.—PUMP AND MOTOR MOUNTED ON SAME BEDPLATE.

improved by the use of these pumps. An electric pump of this kind saves coal bills and does away with the necessity of employing a licensed engineer. Other advantages offered are obvious.

The Walker Company.

The officers of the Walker Company feel indignant over the rumors that have been published in the daily papers regarding an alleged effort said to be making looking to the consolidation of that company with the General Electric and Westinghouse Companies.

President Billings says that there is absolutely no foundation for any such rumors. No negotiations are in progress and he adds that so far as the Walker Company is concerned none are even in contemplation.

Mr. Billings says also that the business of the Walker Company was never in a more satisfactory condition than it is at the present time. The works at Cleveland are running night and day to complete the large orders on hand for big work. Two separate shifts of men are employed.

It is not generally known that the Walker Company will be ready in about 60 days to place upon the market an alternating system, complete from beginning to end, including polyphase machines, transformers and all the etceteras. It will also have a long-distance alternating railway system.

Negotiations are said to have been entered into between the General Electric Company and the Walker Company for the sale to the latter company of the plant of the Brush Electric Company.

The New Haven factory of the Walker Company is kept busy manufacturing the smaller and lighter plants for lighting and railway work. Mr. Charles M. Black, formerly of the Brush Electric Company, is manager of the New Haven factory.

The Walker Company's new arc lamp is practically ready for the market. Excellent results have been obtained from this lamp so far, the experiments having been eminently satisfactory.

Pipe Line Descending the Hill to the Power-House.

At the New Haven factory the company is now building the largest switchboard in the world. It is 100 feet long and fitted for twelve 800 kilowatt generators with 40 feed boards. The cost of the switchboard will be $40,000.

The Walker Company has arranged with Prof. Rowland and Dr. Duncan to manufacture its wattmeter. The New Haven factory will also turn out street railway controllers, switching apparatus, and all the smaller work, while the Cleveland factory will be reserved for large power work.

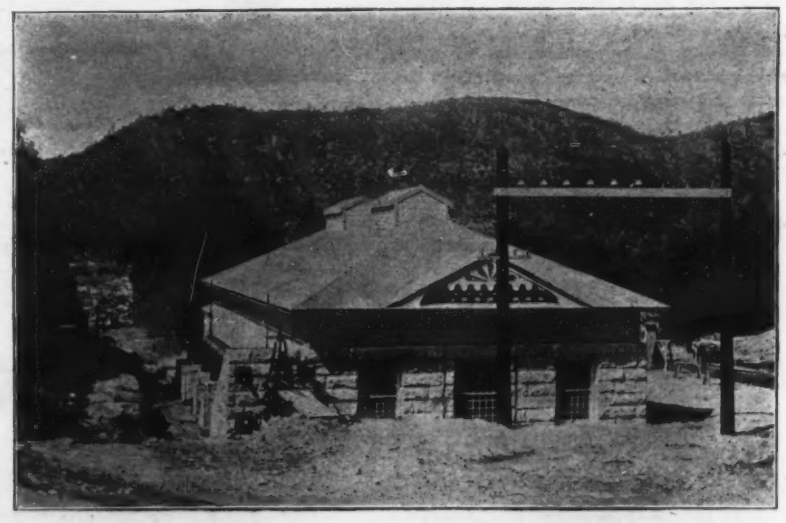
The officers of the company say that their new trolley will be far superior to the trolleys now in use and will not in any respect infringe the Van Depoele patent. They claim also that they could, if they desired, demonstrate that the Van Depoele patent is invalid.

A 35-Mile Electrical Power Transmission.

Fresno, the principal town of the great San Joaquin Valley, in California, was during the last days of May the scene of the completion of a great work, having for result the electrical transmission commercially over the longest distance yet attempted of power generated by an artificial fall of water, unique in its creation and height.

Reservoir.

The City of Fresno stands in the valley of the San Joaquin River, in California, and was founded in 1872, when the Southern Pacific was first laid in the valley. For 13 years its growth was extremely slow, but in 1885 it received an impetus, and in the last 10 years its population has risen to 15,000 persons. Its natural advantages are many. It is the centre of a fertile agricultural region, overspread with a net-work of canals and ditches for irrigation purposes, and has other vast mineral resources as yet undeveloped. It is the commercial centre of the San Joaquin Valley, and would have become a manufacturing city had its aspirations in this direction not been subdued by the extremely high price of fuel and consequent heavy cost of power for manufacturing purposes. This handicap was felt severely by the city as a check upon its growth. All manufactured articles had to be purchased in the East, and when to their cost was added the freight and charges, prices on arrival at Fresno became almost prohibitive. The utilization of the difference of level of the San Joaquin River had been mooted, but not until the successful solution of the problem of long-distance power transmission had been reached did the utilization of the San Joaquin become possible. A company was formed, the San Joaquin Electric Company, to carry out the work, and the General Electric Company's project of three-phase system of transmission, by which power had already been successfully transmitted from Folsom to Sacramento—a distance of 24 miles—was adopted. The work, lacking a few details, is now complete, and Fresno is on a par with any city of the East so far as the cost of power and light is concerned.



Power-House, Showing End of Pipe Line and Receiver Over Pelton Wheels.

The source of the water power is the North Fork of the San Joaquin, which at the point of diversion runs through a narrow canyon with solid rock walls. The minimum low water flow of the stream at this point is 50 cubic feet per second, which at the head used will develop over 7000 horse-power at the water-wheels.

From the point of diversion a flume has been built and a canal excavated and carried along the slopes of a hill for a distance of several miles. They run along a right of way cleared of all obstructions for a width of 150 feet. The grade is 5.28 feet to the mile, and the lower bank forms a roadway for the inspection wagons.

The entire system of headworks and canal is below frost line, and is, therefore, not exposed to any deleterious effects of snow and cold.

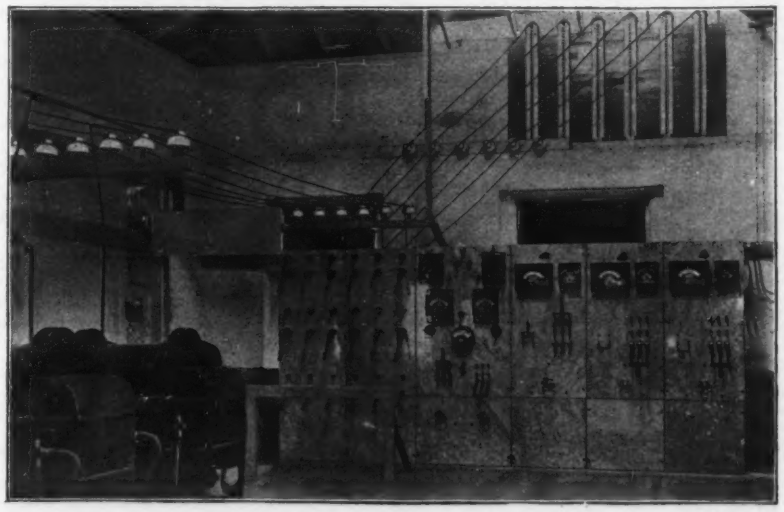
At the end of the canal is a natural basin several acres in extent, surrounded for about three-quarters of its distance by a dyke of rock, which for an expenditure of less than $3000 has been continued in an embankment for the remaining distance and a reservoir for storage water formed, which at a maximum depth of only 10 feet will be sufficient to operate the plant at full load for several days consecutively. This provision will allow of the ditch and flume being shut in case of repair or changes.

INTERIOR OF GENERATOR ROOM.

The reservoir is located at the top of a high hill, the river being some 1600 feet below. From the pressure box in the reservoir the pipe line, 4100 feet long, is brought down the mountain side and in this distance the difference in level between the water in the canal and the water in the river below is over 1400 feet. For the first 400 feet the pipe is steel rivetted, the balance is lap-welded pipe with lock joints and at the lower end is 5-8 inch thick by 22 inches in diameter.

At the power-house the pipe enters a receiver 50 feet long by 30 inches in diameter, of ¾-inch steel, with joints of the butt-strap type. This receiver is designed to stand a working pressure of 800 pounds to the square inch.

The power-house at the bottom of the hill is built of native granite, with a wooden roof. It is 75 feet long by 30 feet wide, and is built on a solid bed rock. The receiver and water-wheels are outside the main power-house, the shafts passing through a heavy granite wall, which effectually keeps all water and moisture out of the dynamo room.



SWITCHBOARD IN THE POWER-HOUSE.

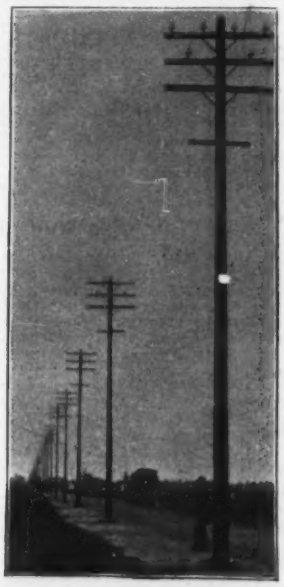
The water-wheels are of Pelton make, 57 inches in diameter, each capable of developing 500 horse-power at 600 revolutions per minute under an effective head of 1410 feet, the highest head ever used for power-transmission purposes. The wheels are constructed with steel-plate centres and bronze buckets, and are fitted with fly-wheels 5 feet in diameter. Separate wheels are provided for the exciters. The wheels which drive the generators are provided with Pelton differential governors.

The electric plant consists of three General Electric three-phase generators, each of 350-kw capacity at a speed of 600 revolutions. The armatures are directly connected to the water-wheels by insulated flange couplings. The exciters used are of the slow-speed multipolar type. The current from the generators is delivered to six 125-kw step-up transformers of the G. E. air-blast type, with secondaries wound for 11,200 volts, to which pressure the current in the transmission line is raised. Provision is left in the generator room for three more transformers of similar capacity. From the transformers, the current passes to the switchboard, which is of Vermont marble, highly polished, as are all the other switchboards used in the installation. The switchboard consists of six panels, three of which are generator panels, one exciter panel and the other two operate the combination of the six transformers and carry special high-tension line switches.

The 11,200-volt circuit, consisting of six bare copper wires, leaves the power-house at the upper end, runs up the stream a few hundred feet, crosses the San Joaquin River with a span of 275 feet wide, and is then led up the mountain for a distance of about 2000 feet. The line continues for about ten miles through a rolling, hilly country, easy of access and at all times below the snow line; the rest of the line runs over a flat country and near Fresno passes through wheat fields and vineyards and follows a special right of way and wagon road for the entire distance. The total length of the transmission line from the power-house to the sub-station is little short of 35 miles, and is thus the longest commercial electric power transmission in the world. The line is strung on special high-tension porcelain insulators made in the porcelain works of the General Electric Company, tested under 27,000 volts alternating pressure before shipment. The poles are square redwood, 35 feet long, set six feet into the ground, and fitted with three heavy cross-arms and one small cross-arm for telephone wires. As a model of pole-line construction the Fresno transmission line can compare favorably with any pole-line work done in the country.

The sub-station at Fresno is almost in the centre of the business portion of the city, and is a brick structure 55 feet by 45 feet. The high pressure circuits entering the house are brought to nine step-down transformers also of the air-blast type. Three of these are of 125-kw capacity, and reduce the pressure to 200 volts, three of 75-kw capacity with secondaries of 1000 volts, and three are of 40-kw capacity, reducing the pressure to 3000 volts. In addition to these transformers the station also contains two 80-light Brush arc machines, directly driven by two 60-hp three-phase induction motors.

The system of distribution from the sub-station is divided up into three net-works. The first, a 200-volt four-wire low-tension net-work which covers the business portion of the town, and having an initial capacity of 6000 16-cp incandescent lamps. The second, a 1000-volt three-phase system, covering the residence districts of the town, and having an initial capacity of 4000 16-cp incandescent lamps. The third, a 3000-volt three-phase circuit designed to furnish current to the numerous vineyards and wineries within a radius of 10 miles from the sub-station, for both lighting and power purposes. Motors will also be furnished with current from both the 200-volt and 1000-volt systems.



THE POLE LINE.

The policy of the operating company is of a broad-guage character, the end in view being the stimulation of the use of electric power. To effect this end prices are made which compare favorably with that charged for power where steam coal costs only $2 per ton. The result of this is that the demand has already taxed the resources of the company, although the plant has not yet been running for one month.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 20, 1896.

TELEGRAPHS.—The announcement of the organization of the New York Telephone Company, in which Western Union interests are largely involved, does not seem to have exerted any apparent effect on the price of stock of the latter. The net result of the week's business show a decline of ⅛, as compared with the week previous. The number of shares sold was 13,000, which is about average trading. Postal Telegraph continues quiet, and is going along in the even tenor of its way.

TELEPHONE.—Bell stock is about the only one in the whole electrical list that shows any marked improvement in price. Quotations show a substantial gain over those of last week. Regarding the incorporation of the New York Telephone Company the Bell people are reported to have said that it is simply a reorganization of the Metropolitan Telephone & Telegraph Company, and that the Bell Company's interests are in no way affected.

DIVIDEND.—The Boston Electric Light Company has declared its regular quarterly dividend of 2 per cent., payable July 15.

SPRINGFIELD, ILL.—The Capital Electric Company has submitted to the city authorities a detailed statement of the business during the year ending May 31, 1896. The statement shows a profit of $16,445 48 to the city. This is the first year's experience of municipal control of the electric light plant.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	118¼	.
Edison Electric Ill., New York	100	95	96
" " " Brooklyn	100	99	102
" " " Boston	100	135	140
" " " Philadelphia	100	137	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29½	30
Electric Storage, pref	100	31	32
General Electric	100	32⅝	33
General Electric, pref	100	73	75
Westinghouse Consolidated, com.	50	..	30
" " pref	50	53½	..

BONDS.

Edison Electric Ill., New York	105	107	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	92½	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	207	208
American District Telegraph	100	38	40
American Telegraph & Cable	100	91½	94½
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	..
Erie Telephone	100	59	60½
New England Telephone	100	91	..
Postal Telegraph-Cable	100	85½	87
Western Union Telegraph	100	84⅜	84⅞

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18¼	18½
Brooklyn Rapid Transit		23¾	24
Brooklyn Traction	100	..	14
" " pref.	100	46	48
Buffalo St. Ry.	100	67	69
Cleveland Electric Ry.	100	..	..
Columbus St. Ry.	100	44	47
Hestonville	100	53⅛	53¼
" pref.		..	62½
New Orleans Traction	100	12	14
" " pref	100	55	60
North Shore Traction	100	25	27
" " pref.	100	75	78
Rochester St. Ry	..	20	25
Steinway Ry.	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14⅜	14¾
West End, Boston	100	70¾	72
" " pref.	100	87¾	88
Worcester Traction	100	15⅞	17
" " pref.	100	88	91

BONDS.

Brooklyn Rapid Transit 5s, 1945	100	78½	80
Buffalo St. Ry. 1st con. 5s	100	105½	*107½
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	93	97
Rochester St. Ry. 1st 5s	100	99½	102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—The market for electric railway securities continues monotonously quiet, the trading being at its lowest ebb. Brooklyn City is the only stock that shows any life, and that is little. On a fair demand for the securities, there was a slight advance on the week's dealings.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, June 22, 1896.

MARRIED.—Mr. Edward E. Higgins, of the *Street Railway Journal*, was married at West Roxbury, Mass., on June 10, to Miss Mary A. White.

DEATH OF A WELL-KNOWN TELEGRAPHER.—John H. Dwight, a well-known and old-time telegrapher, died suddenly in this city a few days ago. He held different positions of prominence in the telegraph service in the past.

LARGE CABLE.—A 40-ton spool of new cable has just been delivered for the Third Avenue cable road. The spool containing the cable was about 12 feet in diameter, and the cable is said to be the largest and longest ever manufactured. It has a length of 25,000 feet and a diameter of two inches.

MR. F. C. FIELD, electrical engineer of the Lafayette Engineering & Electric Works, Lafayette, Ind., has been in New York for the past week. Mr. Field is a native New Englander, a graduate of the Thomson-Houston Works at Lynn, and is in the habit of paying a semi-annual visit to the East.

OBITUARY.—Mr. M. J. Sullivan, formerly manager of the Chicago office of THE ELECTRICAL WORLD, died in Washington, D. C., on June 12, of appendicitis. Mr. Sullivan was well known in electrical and street railway circles. He was an ardent admirer of Mr. Edison, and at one time held the position of advertising manager of the Edison General Electric Company.

MR. WILLARD W. LOW, president of the Electric Appliance Company, Chicago, was in New York a few days ago. Mr Low was looking for Eastern specialties to be handled by his company in the West. Those who have anything in the electrical line to place with any active and energetic jobbing house in Chicago should communicate with the Electric Appliance Company.

REGULATION OF SPEED.—In accordance with the advice of the Corporation Counsel, the Police Commissioners have asked the Board of Aldermen to pass an ordinance regulating the speed of trolley cars around curves, and also pointed out that the existing ordinances do not apply to cable cars. The complaint made to the Commissioners about the curve speed of cable cars and the Corporation Counsel's opinion will be submitted with the request.

MR. H. O. PHILLIPS, treasurer of the Phillips Insulated Wire Company, Pawtucket, R. I., visited New York a few days since on business. Mr. Phillips is highly esteemed in the metropolis, as elsewhere, and the jobbing trade would be glad to see him oftener. The way the Phillips Insulated Wire Company continues not only to maintain but to improve the standard of its goods is what makes the wires of its manufacture so popular both with the customer and the trade.

OPEN CARS ON BROADWAY.—New Yorkers are now rejoicing in having open cars on Broadway. Sixty of them were put into commission a few days ago, and a ride on one of them through the great thoroughfare is a luxury. They are for the present designated as smoking cars, and do not stop on signal for ladies or children. Whenever ladies get an opportunity to board the open cars, however, they do so. The new cars are very attractive and are welcome additions to the equipment.

THE INTERNATIONAL TELEGRAPH CONVENTION now sitting at Budapest has taken up the question of the compulsory use of the official vocabulary for code messages. The resolutions of the New York Chamber of Commerce and other bodies opposing the vocabulary were duly presented by the representatives of the Commercial Cable Company, and the convention on the morning of June 18 decided that the vocabulary shall not be made compulsory and all future action be indefinitely postponed.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, Pa., June 20, 1896.

MR. T. W. MONKHOUSE, of the Reliance Electric Company, who has been confined to his home for several months on account of sickness, is out again and is attending to business as of yore.

THE PHOSPHOR-BRONZE SMELTING COMPANY, Ltd., has just issued a new price list. It is compiled in a manner which makes the information given most interesting. This little publication will be sent free to any one applying for same.

THE ANNUAL DINNER of the electrical section of the Franklin Institute was held at Lincoln Park, on the Delaware, near Philadelphia, on Saturday, June 13. Among the prominent visitors were Mr. John C. Trautwine, chief of the Water Bureau of Philadelphia; Mr. Arther Falkenau, president Engineers' Club; Mr. W. H. Johnson, manager Edison Electric Light Company; Mr. Russell Hawkins, vice-president Bartram Hotel Company; Mr. E. A. Custer, Chief Engineer Harrison Bros. & Co., and Messrs. Zahn and Yunge

of the Tudor Storage Battery Company. Vienna. The president of the section, Mr. Clayton W. Pike, acted as toastmaster, and in addition to those above mentioned responses were made by Past President Carl Hering, Vice-Presidents Thos Spenser and Wm. C. L. Eglin, Dr. A. E. Kennelly, Paul Foster Leach, Mr. F. Uhlenhaupt, Jr, and others.

THE FAIRMOUNT PARK TRANSPORTATION COMPANY has awarded a contract to the Franklin Engineering Company for a bridge across the Schuylkill River at Strawberry Mansion This is a part of the work of building the Park trolley road. The contract price for the bridge is $485,000, and for that amount the company is to turn the structure over complete, including the approaches and the bridge over the Reading railway tracks on the west side of the river. The bridge is to be an ornamental steel structure, supported on stone piers and abutments, and will be 90 feet in height. There will be room on it for a double-track railway, besides a driveway and a footwalk. Work on the bridge and the branch line of which it forms a part must be completed within two years from the date of the approval of the plans by the Park Commission's committee on plans and improvements.

WASHINGTON NOTES.

WASHINGTON, D. C., June 19, 1896.

FALLS CHURCH, VA., expected to have an electric line, but as a question has been raised as to the legality of the special election held May 28 to issue bonds for $10,000 to aid the project, the matter will probably be dropped.

BUSINESS VISITS.—Mr. Scarborough, of Vallee Bros., & Co., Philadelphia; Harry B. Reed, of the Bishop Guttapercha Company, New York, and Mr. Brewster, of the New York Insulated Wire Company, New York, were in Washington this week on business.

SUIT.—The managers of Mount Vernon Park, on the electric railway near Mount Vernon, have entered suit against the Washington, Alexandria & Mount Vernon Electric Railway Company claiming $25,000 damages for nonfulfillment of their contract in not running trains to the park as agreed and for charging 40 cents per round trip when the rate should be only 25 cents.

A PECULIAR ACCIDENT happened in Alexandria, Va., the other day. A trolley car was moving rapidly along one of the streets and the trolley by some means jumped the wire and struck a guy wire. Poles for nearly a square fell like ten-pins, one striking the car. No one was in the car at the time, however, and while the car was not badly damaged, travel was impeded for some time.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., June 19, 1896.

DECATUR, ILL.—Judge Vail, of the Circuit Court, appointed H. C. Montgomery receiver of the Municipal Electric Light Company. Mr. Montgomery will take charge of the property at once and conduct it until further orders. The bond is $30,000.

TO REHABILITATE AN OLD ROAD.—A company is about to be organized to buy up the old motor line from Milwaukee to North Greenfield, and build an electric line from North Greenfield to Waukesha. Mr. J. N. Vandegrift, of Philadelphia, has gone West to stake off the proposed electric road.

THE ELECTRIC APPLIANCE COMPANY is carrying in Chicago a well assorted stock of Electra carbons, and is prepared to fill orders at manufacturers' prices. It claims that the Electra carbon is the cleanest imported carbon on the market, burning with the least possible amount of dust, hence giving a longer life than would otherwise be possible.

MR WILLIAM D RAY, general manager of the Everett Railway & Electric Company, of Everett, Washington, formerly associated with the Standard Electric Company, is in the city for two weeks. Mr. Ray will be remembered as electric light inspector of the Chicago & Northwestern Railway, and electrician of the Northern Pacific Railroad Company in past years. "The Practical Applications of Electric Machinery," which has had a large sale, was written by Messrs. MacFadden and Ray during 1893. Mr. Ray, after an absence in the Far West of some two years, is calling on his many friends.

PARIS NOTES.

(From Our Own Correspondent.)

PARIS, June 4, 1896.

The regular meeting of the Societé des Electriciens was held on the 3d of June. Mr. Bochet presented a paper on "Electrical Conductors." He first established formulas giving the weight of copper necessary in an installation with admitted losses, then the conditions necessary for a minimum. He also examined the problem of branch circuits. M. Caintinier gave a description of the railway operating between the Place de la Republique and Romainville. This is the underground system of Claret-Vieulleumier first displayed at the Exposition of Lyons in 1894. It consists of two conductors, one of which is connected to the rails and the other in series with the distributing boxes. Each box contains a turning commutator which is successively placed in series with brass plates on the rim. By the aid of an electromagnet which closes the circuit at the moment when the car is above it, the commutator is moved and turned to another plate. Each plate is connected by a conductor with a plate of iron placed on the surface and insulated, and the current is transmitted This new system has proved very interesting. Electrical energy is furnished by a plant installed at Lilas, which consists of three boilers having a capacity of 2000 kilograms of water per hour and three Corliss-Garnier horizontal condensing engines of 200 horse-power, running at 87 revolutions per minute. These are directly belted to three Hillaird over-compounded generators of four poles, 530 volts and 300 revolutions per minute. Paralleling the railway are laid the conductors 4700 metres in length, which serve for lighting the public places.

General News.

NEW INCORPORATIONS.

THE KOKOMO TELEPHONE & ELECTRIC MANUFACTURING COMPANY, Kokomo, Ind., has been incorporated with a capital stock of $5000.

THE RIPON TELEPHONE COMPANY, Ripon, Wis., has been formed by T. S. Chittenden, G. F. Horner and Louis Pynch, with a capital stock of $1000.

THE ELECTRIC STREET RAILWAY COMPANY has been incorporated at Clarksville, Tenn., by N. L. Carney, R. H. Burney, M. F. Shelton, Julien Gracey and H. P Cholson.

THE AURORA & GENEVA RAILWAY COMPANY, Aurora, Ill., has been organized with a capital stock of $10,000. The promoters are D. A. Belden, F. H. Thatcher and E. D. Mix.

THE OHIO AUTOMATIC FIRE ALARM COMPANY, Dayton, O., has been incorporated by George Winchet, Walter F. Phelps, Eugene Winchet, J. M. Phelps and Edward Winchet. Capital stock, $25,000.

THE ROBINSON COMPANY, Chicago, Ill., has been incorporated by E. E. Billow, E. A. Robinson and W. S. Ryerson, for the purpose of manufacturing and selling electrical specialties. Capital stock, $2500.

THE SILEX INSULATION COMPANY, Nyack, N. Y., has been incorporated in West Virginia by Abraham Garrison, Edward C. Arthur and Oscar Moble, New York City, and Frederic J. Nash, Brooklyn, N. Y. Capital stock, minimum, $500; maximum, $1,000,000.

THE WAPAKONETA & KENTON RAILWAY COMPANY, Wapakoneta, O., has been organized with a capital stock of $100,000, for the purpose of building an electric railway between Wapakoneta and Kenton. The promoters are L. N. Blume, Jacob Hess, M. D. Shaw and C. T. Kolter.

TELEGRAPH AND TELEPHONE.

SYRACUSE, N. Y.—There is a movement on foot to require all electric wires in this city to be placed under ground.

CHARDON, O.—The Chardon Telephone Company has been granted a franchise to build a line between Chardon and Painesville, O.

VALPARAISO, IND.—A. J. Stahl, of La Porte, Ind., has been granted a franchise to build a telephone line throughout the county.

LONG-DISTANCE TELEPHONE IN ST. LOUIS.—The American Telephone & Telegraph Company opened its office in St. Louis on June 24.

INDIANAPOLIS, IND.—Arrangements have been made by the Western Union Telegraph Company to place its wires in this city under ground.

HUNTINGBURG, IND.—It is stated that the Cumberland Telegraph & Telephone Company, of Nashville, Tenn, will establish a telephone exchange in this place.

GREAT FALLS, MONT.—The stockholders of the Great Falls & Lewiston Telephone Company have declared a dividend of 16 per cent. on the capital stock. The company's lines will be extended.

RICHMOND, KY.—The Berea & Richmond Telephone Company has been consolidated with the local system of this place. This gives connection between Berea, Kingston, Caleast, Silver Creek, Whitehall and Richmond.

KANSAS CITY, MO.—Several wholesale jewelers of this place will order their telephones removed on July 1 next, unless the telephone company complies with the city ordinance restricting telephone rentals to $36 a year.

LOWELL, MASS.—An ordinance has been introduced in the City Council to provide for an inspector of wires. It is stated that such an official is necessary as there is no proper supervision of electric wires at the present time.

TREMPEALEAU, WIS.—The extention of the Trempealeau telephone line from Centerville to Arcadia has been sold to a syndicate of five citizens of the latter place. The lines will be extended to connect with the Winona telephone lines.

WILLIAMSPORT, IND.—The Central Union Telephone Company, of Lafayette, has been granted the right of way through this county to build a telephone line from Lafayette, Ind., to Danville, Ill. A franchise has also been granted to the Williamsport Electric Telephone Company to erect lines in this vicinity.

DETROIT, MICH.—The Detroit Telephone & Construction Company, having expended $10,000 in the construction of its plant in this city, the city will return to the company the guarantee check for $5000, deposited by the company as evidence of good faith, which was required by the ordinance granting the franchise.

EAST ST. LOUIS, ILL.—The City Council has granted permission to the American Telegraph & Telephone Company to erect a line through certain streets in order to enable the company to reach the Eads Bridge and pass over the river to St. Louis. The company will pay $100 per annum for this franchise, and maintain an office in East St. Louis.

ELECTRIC LIGHT AND POWER.

PITTSBURG, PA.—The National Galvanizing Works now in course of erection at Versailles Borough, will be operated entirely by electric power.

VICKSBURG, MICH.—The courts have decided the recent election on the electric light question to be irregular. The Council has ordered another election.

CHATTANOOGA, TENN.—The officials of the Chattanooga Electric Light & Power Company will soon advertise for bids for the erection of its new buildings.

BRIDGEPORT, CONN.—Judge Hall has granted an order instructing the receiver of the Norwalk & South Norwalk Electric Light Company to bring suit against the City of South Norwalk to compel it to buy the electric light plant of the company, and giving the receiver permission to apply for an injunction to restrain the city from running at electric light plant.

McKEESPORT, PA.—The Common Council of this city has passed an ordinance granting to the Fort Wayne Electric Corporation, Fort Wayne, Ind., the contract for a municipal electric lighting plant in this place. A petition signed by 173 citizens protesting against the action of the Common Council was presented in the interest of the McKeesport Electric Light Company, which sought to renew its old contract.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company has closed a contract with the Electric Storage Battery Company, of Philadelphia for the installation of a storage-battery plant. The Woonsocket Company intends to use this plant both for lighting and railway work. The plant will consist of 280 cells of type G 11, each having a capacity of 800 ampere-hours. The improvement will cost $25,000.

THE WESTERN ELECTRIC LIGHT, POWER & WATER COMPANY, Weston, W. Va., announces that it will increase its electric plant by July 15, from 60-kw to 150-kw capacity, and wishes two 75-kw, 125-volt, M.P. dynamos, either direct or belt connected; also a 200-hp Corliss engine. No objections to second-hand if low in price and in good condition.

LARGE MOTOR.—What is said to be one of the largest electric motors ever placed on a public platform for instruction purposes was harnessed up and its workings explained by an expert in Johnstown, Pa., at a public meeting held on the evening of June 18. The occasion was an industrial exhibition, given by the Board of Trade, showing the new industries established in Johnstown during the present year. The motor was made by the Steele Motor Company, recently established in Johnstown, and weighed over a ton.

LOGANSPORT, IND.—A force of men, under the direction of the Electric Light Committee of the Common Council, was set at work tearing down the wires and cutting down the line poles of the Jenney Electric Light Company, as per a recent order of the Council. Since the city has put in an electric lighting plant of its own the lines of the Jenney Company have been a hindrance and the competition has caused the city plant to be operated at a very small profit in furnishing private customers. The Jenney Company has operated here since 1888 without a franchise and it is by the advice of the City Attorney that the lines and poles are being torn down.

The Electric Railway.

NEW CASTLE, PA.—The proposed extension of the New Castle car lines is being discussed.

EVERETT, MASS.—A franchise has been granted to the West End Street Railway Company to lay double tracks on Broadway to the Malden line.

PITTSBURG, PA.—J. D. Scully says that the West Side Belt Line Railway will be built as soon as the right of way is secured outside the city limits.

NEW YORK, N. Y.—The Metropolitan Traction Company has very largely extended its system of transfers in the section of the city below Fifty-ninth Street.

BUFFALO, N. Y.—The Buffalo Railway Company is making preparations to double track its road along North Elmwood Avenue. The improvement will be carried south of the bridge.

VERNON CENTRE, CONN.—A survey is being made for an electric road through Vernon Centre. The proposed line will run north to Rockville by way of West Road to West Street station.

CINCINNATI, O.—The Cincinnati, Newport & Covington Street Railway Company is making arrangements for the construction of its proposed electric lines at an estimated cost of about $1,000,000.

TROY, N. Y.—The New York State Railroad Commissioners have granted permission to the Mountain Lake Electric Railway Company to construct an electric railway from Gloversville to Mountain Lake.

BOSTON, MASS.—It is stated that the City of Boston pays $25,000 per annum to the West End Street Railway Company for tickets for city employees. The railway company allows no discount on these tickets.

BROOKLYN, N. Y.—The Coney Island & Brooklyn Railway Company, on June 16, sent to the Corporation Counsel's office a check for $30, in payment of a judgment obtained against the road by the city for violation of the speed ordinance.

HOMEWOOD, PA.—The Consolidation Traction Company has purchased land comprising three blocks on Frankstown Avenue opposite Homewood Park, on which will be erected new car barns and repair shops. Work will be commenced immediately.

TAUNTON, MASS.—The Board of Aldermen have granted a franchise to the Brockton, Bridgewater & Taunton Street Railway Company to lay tracks in this place. The only restrictions relate to 5-cent fares, the care of streets and time for completing the work.

ASHLAND, PA.—The Borough Council of Ashland has granted the right of way to the Manancy Valley Electric Railway Company to erect a railway from Ashland to Delano. They also granted the same right to the Ashland, Centralia and Locust Gap Railway Company.

NIAGARA FALLS, N. Y.—The contract has been awarded by the Lewiston & Youngstown Frontier Electric Railway Company for the electric power and conductors to the Schoellkopf Company, of this place. The feeder cable will be six miles long and will carry the current from here to Lewiston.

ELIZABETH, N. J.—It is stated that the franchise recently granted to the Elizabeth Street Railway Company has proved to be irregular, since notice of the application for the grant should have been published two weeks prior. A new application will be made in a manner to conform to the law.

TRIADELPHIA, WEST VA.—The Board of County Commissioners met for the purpose of considering the proposed right of way asked for by the Suburban Railway Company from Triadelphia to the State line at West Alexander. The plans were gone over and an ordinance was passed granting the privilege.

TROY, N. Y.—The Stillwater & Mechanicville Street Railway Company has placed a fine steamboat on the river to run between Stillwater and Schuylerville in connection with the railway from Mechanicville. The company intends to arrange low excursion rates from Troy and Albany to Schuylerville and return.

SYRACUSE, N. Y.—The Reorganization Committee of the street railway systems has decided to make numerous changes in the construction of the road beds of most of the city lines. The owners of the railway systems contemplate increasing the capacity of the Park Avenue and Tracy Street power-house, so as to furnish power for all of the lines in the city.

NEW HAVEN, CONN.—The Manufacturers' Railway Company will next week begin the construction of its line, which will be 1¼ miles long and used only for freight purposes. It will run in connection with factories in the eastern part of the city, and the New Haven steam railway station. It is stated that 24 electric locomotives of the Baltimore & Ohio pattern have been ordered. This will be the first trolley line in the State to carry freight.

MILWAUKEE, WIS —The street railway boycott was formally declared "off" on June 19 by President James Flint, of the Amalgamated Association of Street Railway Employees, that is, declared off as far as it lies within his power to do so. He said that the organization had discontinued running buses, and no longer asked the public to refrain from riding in the cars. He said, however, that the strike itself had not been declared off.

FRANKFORT, IND.—At a citizen's meeting at the Council chamber, to consider the question of this township voting a $60,000 subsidy to procure the proposed electric railway (Logansport and Indianapolis), it was decided to appoint a committee of representative citizens to inquire into the benefits that the city would be likely to derive and the standing of the proposed builders. It is probable that an election will be called to vote on the question early in July.

NEW YORK, N. Y.—It is reported that the Third Avenue Railway Company is about to begin the construction of an overhead trolley line from 162d Street to Kingsbridge, a distance of four miles. It had been generally supposed that the company would extend the underground conduit system which it has been using experimentally for some weeks past, but it states that the bid made for the franchise was so large that it was compelled to adopt the cheaper method of construction. The overhead trolley line can be constructed in a few months, whereas the cable or underground trolley system would require two years to build.

BROOKLYN, N. Y.—The express trolley cars went into active service on the Brooklyn Heights Railway Company on June 15, and it is stated that they are giving much satisfaction. The public has already appreciated the advantages of the service by making use of it, and at the several stations wagon-loads of packages were waiting for the arrival of the cars on the first day. The motormen of these cars have strict orders that they must not in any way interfere with the operation of the passenger cars. About 100 branch express offices will be opened, and every effort will be made to render the service of the greatest benefit to the public.

Legal Notes.

BROOKLYN, N. Y.—Civil Justice Van Wart in a decision handed down on June 16 held that the Brooklyn Heights Railway Company had wilfully and negligently violated the speed ordinance.

TRENTON, N. J.—Judge Green in the United States Circuit Court reserved decision upon a motion for a preliminary injunction made by Herbert W. Gindal, solicitor for the complainant, in the suit of the Scott Electric Lamp Company, of New York City, against Samuel W. Rushmore, of Jersey City, brought for an alleged infringement of an electric searchlight patent. Charles M. Catlin, of Washington, D. C., counsel for the defendant, opposed the motion.

LITIGATION ENDED.—Nearly two years ago suit was instituted in Brooklyn to declare invalid the franchise granted to the Nassau Railway Company. On June 15 the Brooklyn Board of Aldermen gave Corporation Counsel Burr permission to withdraw from the appeal in the suit, Mr. Burr having recommended that further litigation in the case be dropped because the terms proposed by the company were satisfactory to the city. This action of the Board of Aldermen closes the franchise fight.

TRENTON, N. J.—The Court of Errors and Appeals on June 15 rendered a decision in the case of Mrs. Washington A. Roebling against the Trenton Traction Company. A trolley pole was erected in front of her mansion on West State Street, this city, in opposition to her wishes The case was carried to the Supreme Court and decided against Mrs. Roebling, which decision is now affirmed by the Court of Appeals, as above mentioned. The Supreme Court decided that ordinances granting to trolley companies the right to erect poles in front of private property without the consent of owners are not unconstitutional. The court says that if Mrs. Roebling can show special damages she may find redress by suing to recover.

INJUNCTION ASKED FOR.—An injunction has been asked from the Court of Chancery in Jersey City, to restrain the North Hudson County Railway Company from laying new rails on Washington Street, Hoboken. The company is desirous of running a trolley line through that street to take the place of the horse cars, and it claims the right to replace the present rails without asking the consent of the Common Council. The Council passed a resolution recently ordering the company to quit work. Mayor Fagan vetoed the resolution, and intimated that the Councilmen had mercenary motives for their action. The resolution was passed over the Mayor's veto, and notice was served on the company. No attention was paid to the notice, and the company kept right on laying the new rails. The company holds that it is only repairing the existing road and that it has a right to do that without asking the consent of the Council. An early decision on the application for the injunction is looked for.

Trade and Industrial Notes.

THE WELLS MANUFACTURING COMPANY, New York, Edward Robinson, sole proprietor, has just issued a new circular of the Wells Light. It is very complete, and the wide range of application of this light is well illustrated.

"A HANDFUL OF TRUMPS" is the title given to a neat little pamphlet just issued by the Rollins Engine Company, Nashua, N. H., giving testimonials from a few users of the Rollins engines. Electric light companies and electric railway companies are using these engines with satisfaction.

KOCH DYNAMO BRUSHES.—In a little folder issued by Goldmark & Wallace, New York, selling agents for these woven wire tube dynamo brushes, are given a description of the manufacture of the brush, and sizes and price-lists of the same. These brushes are said to possess several meritorious features.

THE GENERAL ELECTRIC COMPANY has purchased the stock of the Southern Electric Manufacturing & Supply Company, New Orleans, La., and has succeeded to the business thereof. It will increase the stock of the Southern Company, and extend the business in every way possible. The customers in the Southern territory will thus be supplied more promptly and satisfactorily than ever before from the New Orleans store room.

FLEXIBLE MICANITE.—We have received from the Mica Insulator Company, New York, a sample of its flexible micanite plate which is made from pure India sheet mica, and is the latest production of this particular kind of insulation. Its extreme flexibility permits of it being bent into any shape. The demand for micanite specialties is said to be on the increase both here and in Europe, and the company's factories at London and Schenectady are kept busy.

EDWARDS BROS. & CO., managers of the General Manufacturers' Display Bureau, have moved from 90 West Broadway to 139 Duane Street, where they have 9300 square feet of space at present and an option on 37,000. The object of this concern is to represent manufacturers outside of New York City, on a commission basis, and to provide space for samples of the goods, charging therefor a nominal sum. This is a new enterprise, and the managers are receiving very flattering encouragement.

THE PALERMO MICA COMPANY, 27 Peck Slip, New York, miner and importer of mica, is now making a specialty of mica for electrical purposes. This company, which had an exhibit at the World's Fair, received the highest award. It is one of the oldest miners of mica in this country, and its mine located in New Hampshire has proven one of the most productive. Mr. J. E. Bonder, secretary and general manager, states that the company is prepared to furnish the electrical trade promptly with the highest grades of sheet mica, cut and uncut.

WORLD'S FAIR MEDAL AND AWARDS.—The New York & Ohio Company, Warren, O., has just received its World's Fair award and medal. This award makes particular mention of the maintenance of candle-power and freedom from blackening which are prominent qualities of the Packard incandescent lamps. The company feels especially gratified at this award owing to the fact that the lamps were bought in open market by the Electric Appliance Company, Chicago, at a time when the New York & Ohio Company was under injunction from the General Electric Company, which prohibited it from making lamps for the test.

HINE & ROBERTSON, the well-known steam specialty manufacturers, and New York agents for the American Feed-Water Heater, have made recent sales of this heater as follows: 1000-hp, Coney Island Railway, Brooklyn; 700-hp, ordered by Watts & Campbell for Fall River, Mass.; 600-hp, American Manufacturing Company, Green Point, Brooklyn; 600-hp, Holmesburg & Bristol Passenger Railway Company, Bristol, Pa.; 500-hp, Asbury Park Water Works; 300-hp, Flower City Reduction Company, Rochester, N. Y.; 200-hp, Teller Bros., Newark, N. J.; 200-hp, New York Mutual Gas Light Company, New York; 200-hp, Atlantic Highlands Electric Light Plant. Mr. F. S. Scott, who has charge of this department, is congratulating himself upon his success in this line. Mr. Robertson reports a very good business in his various lines of steam specialties.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 16, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

561,958. AUTOMATIC ELECTRIC SWITCH; W. S. Barstow, Brooklyn, N. Y., and R. Lindsay, Cleveland, O. App. filed June 5, 1895. The combination with a driven shaft of a motor, of notched discs or cams driven thereby, a switch arm controlling the continuity of an electric circuit and movable upon its support. and spring for moving the switch arm and stops controlled by the movement of said discs for determining the position of the switch arm.

561,975. ELECTROGALVANIC BELT; A. Dow, Wooster, O. App. filed Feb. 17, 1896. In an electrogalvanic belt, the combination with a suitable belt, of battery electrodes attached thereto, a battery detachably coupled to said electrodes, two negative body electrodes connected in parallel electric relation to each other and with one of the battery electrodes and a positive body electrode in electrical connection with the other battery electrode.

561,977. ELECTRICAL ENERGY INDICATOR; T. Duncan, Fort Wayne, Ind. App. filed Nov. 11, 1895. The combination with a movable scale, of a wound armature, a commutator, spirally constructed brushes pressing against said commutator, and two series-coils located inside of said movable scale. (See Illustration.)

561,982. ELECTRICAL PILOT OR SIGNAL; H. H. Franklin, Brooklyn, N. Y. App. filed March 18, 1896. An electrical alarm adapted for use on board a vessel and for determining the depth of water, which consists of a casing which is suspended by a cable, through which pass two conductors, said casing being provided with a shaft which passes centrally therethrough and with an arm connected therewith to complete the circuit through said conductors, said shaft being provided at each end with arms, to which is secured a pendulum which is adapted to come in contact with the ground.

61,991. TROLLEY; J. H. Holland and P. F. Glazier, Indianapolis, Ind. App. filed Aug. 23, 1895. A bushing for trolley wheels the body of which is constructed from some material which is practically a non-conductor of electricity and having a series of indentations at intervals of its outer surface filled with lubricating material and having alternating belts of rawhide throughout the surface of the bushing.

562,004. TELEGRAPHY; E. F. Law, London, England. App. filed Jan. 8, 1895. The combination in a telegraph system, of two separate stations united by a single line or conductor, a rotating arm, a series of electrical contacts, a branch wire connecting each contact with a communicating instrument, and a multiple contact switch, including one pair of contacts in each of the last named circuits or branches, so arranged that the movement of said switch the space of one step or interval transfers the receiving instrument of one line or branch to the next adjacent line or branch.

562,009. TELEPHONE SWITCHBOARD; G. S. Maxwell, Richmond, Va. App. filed March 17, 1896. In a telephone switchboard, switching levers, switching cords and loops adapted to engage the levers, and a magneto generator or other source of electricity having its terminals adjacent to the said loops when hung upon the levers, whereby a little movement of a loop when so hung will connect one of the said terminals with a lever for the purpose of energizing the line to sound a signal.

562,010. TELEPHONE SWITCHBOARD; G. S. Maxwell, Richmond, Va. App. filed March 17, 1896. In a telephone switchboard, a subscriber's line, a drop, and a spring jack thereon, and a switch connected therewith, an insulated metal portion to the switch, and a shunt circuit line between the said spring jack and the subscriber's line beyond the drop, the said metal portion of the switch located in and normally completing the said shunt circuit.

562,011. TELEPHONE SYSTEM; G. S. Maxwell, Richmond, Va. App. filed March 17, 1896. In a telephone system an annunciator and a telephone receiver at a central exchange; a telephone instrument at a subscriber's station and a ground wire therefor, a system of wires and connections for the instrument and annunciator; a call-wire for connecting the said instrument and receiver, and a switch for connecting the instrument with either the ground-wire or the said call wire.

562,012. TELEPHONE SWITCHBOARD; G. S. Maxwell, Richmond, Va. App. filed March 20, 1896. In telephone switchboards, the combination of a table carrying spring-jacks, switches and connecting plugs, and a board carrying annunciators and a transmitter, the said board and table being hinged together.

562,013. TELEPHONE SWITCH; G. S. Maxwell, Richmond, Va. App. filed March 25, 1896. In a telephone circuit, a magneto-generator bell and retardation-coil connected in series with each other and in multiple with the receiver and induction coil in combination with suitable circuit-changing devices whereby the retardation-coil is brought into the signal-circuit when the talking-circuit is being used and is short-circuited when the signal-circuit is in use.

562,119. PRIMARY BATTERY; R. P. Osgood, Salem, Mass. App. filed Sept. 30, 1895. In an electric battery, the combination of a containing-jar, a copper cup suspended therein and provided with openings closed by fibrous material, a positive pole suspended within said cup and a partition of felt between said poles.

562,030. PENCIL FOR ARC LAMPS; I. L. Roberts, Brooklyn, N. Y. App. filed Oct. 31, 1895. An electrode or pencil for arc lamps composed of a cylinder or holder or carbon with a core of a material containing chromium.

562,034. FIRE-ALARM SIGNAL-BOX; J. J. Ruddick, Newton, Mass. App. filed Oct. 8, 1894. A fire-alarm signal-box comprising a break-wheel or signaling device, and an actuating-motor therefor with an electromagnet included in the circuit and an armature therefor and means whereby the box is rendered inoperative to transmit the signal when said armature is in retracted position, and a latch which engages said armature when retracted and retains the same in retracted position, and a lock operated by the actuating-motor to engage with and lock the armature after the motor is started and before the circuit is broken in response to the operation of said motor.

562,055. RAIL BOND OR CONNECTION; H. P. Wellman, Catlettsburg, Ky. App. filed July 9, 1895. A bond wire or connection consisting of iron or

steel terminals and a copper rod or bar joining the same and electrically welded thereto with a gradual welding or fusion of the one metal into the other.

562,062. REGULATING ALTERNATING MOTORS; A. H. Armstrong, Schenectady, N. Y. App. filed Jan. 11, 1896. In combination, an induction motor having a revolving and stationary part with a ratio of transformation other than one to one and a switch adapted to interchange the terminals of the revolving and stationary parts.

562,090. ELECTRIC ARC LAMP; M. S. Okun. App. filed April 8, 1892. A globe having its upper end closed from the outside air, and a carbon-holding rod, combined with a mounting at the lower end of the globe, a frame, a carbon holder adapted to permit gases to pass to said frame and a valve connected with said frame. (See Illustration.)

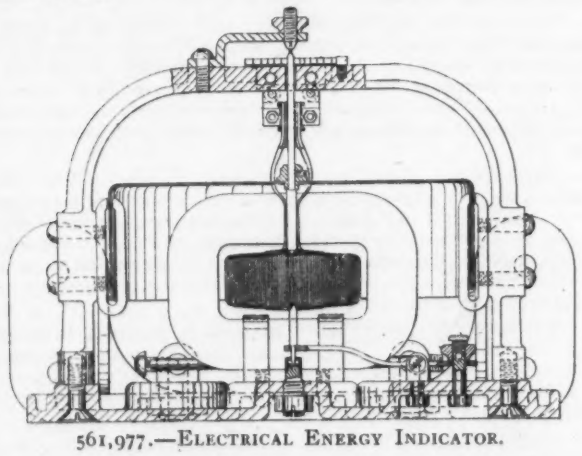
562,100. CONTROLLER FOR ELECTICAL CARS; E. A. Sperry, Cleveland, O. App filed March 20, 1896. The combination with a controller-cylinder, of a reversing switch, operating connections between the cylinder and the movable contacts of said switch, and means for reversing the relative movement of said contacts when the car is to run in the opposite direction.

562,107. ELECTRIC RAIL BOND; W. H. Wiggin, Worcester, Mass. App. filed Aug 28, 1895. An electric rail bond comprising a flexible bond wire consisting of a wire rope or other flexible material, a piece attached to each end thereof, each having a shoulder whereby it may be driven longitudinally into a collar fitted in the air-flange, and also provided with a longitudinal opening at the opposite end from said shoulder and said collars, one for each end of the bond adapted to fit in said rail-flange and to receive said metal pieces.

562,116. CONTROLLER FOR ELECTRIC MOTORS; E. A. Bryant, Washington, D. C. App. filed April 18, 1896. In combination with a suitable resistance coil or device, a treadle or lever adapted to bring the resistance into or remove it from circuit as the lever is rocked, and a short-circuiting switch or device mounted upon the lever and adapted to open or close a path for the circuit around the armature independently of any movement of the lever.

562,132. TROLLEY FOR ELECTRIC RAILWAYS; M. T. Graf, Buffalo, N. Y. App. filed Jan. 14, 1896. The combination with the yoke of a trolley pole, having sockets of a trolley wheel and its axle, and its supporting arms carrying side axle and having shanks or extensions seated in the yoke-sockets.

562,142. ELECTRIC SWITCH; J. F. McElroy, Albany, N. Y. App. filed Dec. 29, 1894. In an electric switch, a cylinder principally composed of insulating matter carrying a connecting plug at one end thereof in permanent electrical connection, with a source of electrical supply through the axle thereof, brushes arranged to receive electricity from said plug, and secondary plug in the periphery thereof to electrically connect corresponding brushes, one of which is electrically connected with one of the first named brushes.



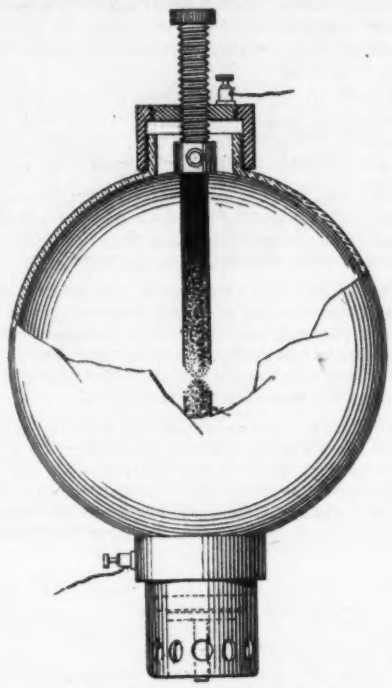
561,977.—Electrical Energy Indicator.

562,166. INSULATOR; T. Blankinsop and J. W. Brown Martin's Ferry, O. App. filed March 24, 1896. A glass insulator for wires, having a head formed with a wire engaging groove and a screw stem joining the head by a shoulder and reinforced by an embedded metal plug or core extending above said shoulder into the head.

562,179. DYNAMO-ELECTRIC MACHINE AND ELECTRIC MOTOR; J. G. Germann and F. B. Downing, Erie, Pa. App. filed March 26, 1896. In a motor or dynamo the combination with the armature, of the field magnet core having its shoe in proper relation to the armature, and a support for said field magnet core hinged off the centre of said shoe to allow the free movement of the field magnet core and coil away from the armature, and having the axis of the hinge in a plane substantially at right angles to the axis of the armature.

562,209. ELECTRIC DISTRIBUTION SYSTEM; R. R. Bowker, Brooklyn, N. Y. App. filed Feb. 27, 1896. In an electric distribution system, a supply station, a network of street conductors receiving current therefrom and controllable switch-boxes interposed in series in said street-conductors and a controlling-circuit including the actuating apparatus of said switch-box and operated from said station, whereby when said switch-boxes are controlled to break circuit a portion of said network of conductors may be electrically cut off from said supply station.

562,216. ELECTRIC RAILWAY SYSTEM, ETC.; C. Coerpor, Cologne, Germany. App. filed April 4, 1896. An electric railway system consisting of primary conductors overlapping secondary conductors, transformers interposed between the main and secondary conductors, and magneto-electric switch devices by which the primary windings of the transformers are automatically switched in as soon as the contacts on the car connect the overlapping portions of two adjacent conductors parallel with each other and by which the primary windings of the transformers are likewise automatically cut out as soon as no further current is required on the adjacent secondary conductors. (See Illustration.)



562,090.—Electric Arc Lamp.

562,253. AUTOMATIC BLOCK SYSTEM; J. Shoecraft, Harveyville, Kan App. filed Aug. 8, 1895. An automatic block system for railways, provided with a signal shaft adapted to be revolved, a stopping lever for the said shaft, and a spring motor adapted to engage when expanded, the said lever when the motor is nearly run down to stop the signal shaft at the danger position.

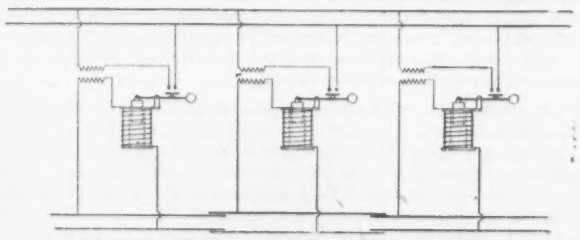
562,261. TESTING JOINT FOR ELECTRIC CONDUCTORS; B. L. Toquet, Westport, Conn App. filed April 14, 1896. A testing joint for electrical conductors consisting of a yoke with perforated ends through which the conductors pass, and to which they are connected, and an interposed insulating bushing and adaptable contact screw to make or break electrical connection across the insulation.

562,313. ELECTRIC ARC LAMP; O. S. Lyford, Jr., Chicago, Ill. App. filed April 6, 1896. In an electrical arc lamp, the combination with an enclosing chamber for the carbon electrodes normally sealed from the external air, of a porous or fibrous diaphragm for securing the equalization of any substantial difference between the external and internal pressures upon the walls of said enclosing chamber.

562,318. RAILWAY SIGNAL; F. McBrien, Newark N. J. App. filed April 1, 1896. A railway signal system comprising a plurality of track sections insulated one from another, a plurality of signal devices, a motor for operating each signal device, a neutral relay and a polar relay, controlling the motor circuit, a circuit including the track rails and common to both relays and electromagnet devices for reversing a battery with relation to the track circuit when the train leaves the protected region of the track.

562,325 ELECTRIC BURGLAR ALARM; H. Rohrdantz, Buffalo, N. Y. App. filed Jan. 30, 1896. The combination of a motor, circuit wires connected thereto, one wire being insulated therefrom, a spring arm extending from the insulated wire, a roller on the extremity of said arm, and a circuit-closer adapted to be rotated by the motor and to contact with said roller which projects slightly in its path, the roller serving to pass the circuit-closer by slight deflection of the spring arm without stopping the motor.

562,353. THERMOSTAT; E S. Brazelton, South Pittsburg, and T. J. Zoeller, Nashville, Tenn. App. filed May 1, 1895. In a thermostat, in combination, a frame having an annular groove, a section of a hollow sphere of thin metal having its perimeter flanged, a spring ring whereby it may be firmly clamped in place in such frame and co-operating contact pieces.



562,216.—Electrical Railway System.

562,356. TROLLEY WIRE SWITCH; S. D. Cushman, Akron, O. App. filed Feb. 25, 1896. An improved trolley-wire switch having line and switch-wire terminals, and rocking tongue to bring either switch-terminal in alignment with the main terminal, of clasps on said terminals to fasten them to the wires and studs to support said wires on either side.

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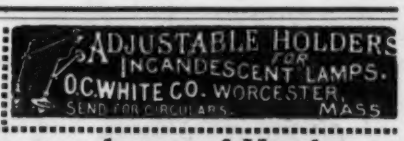

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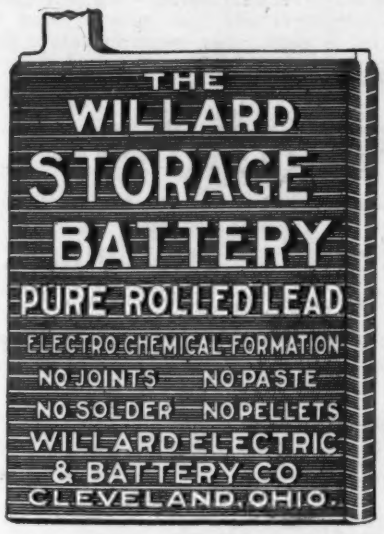

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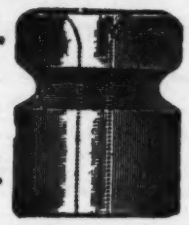

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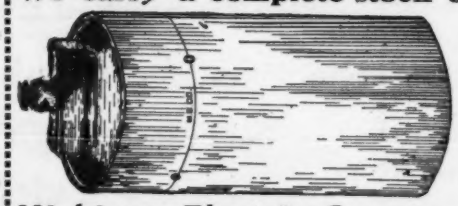

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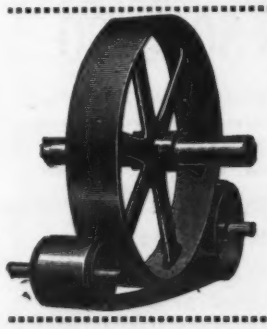

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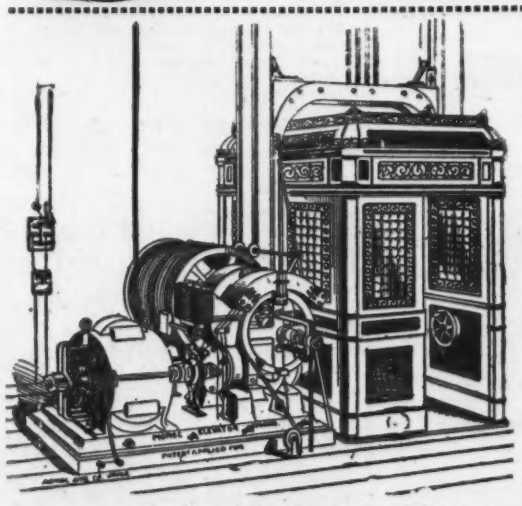

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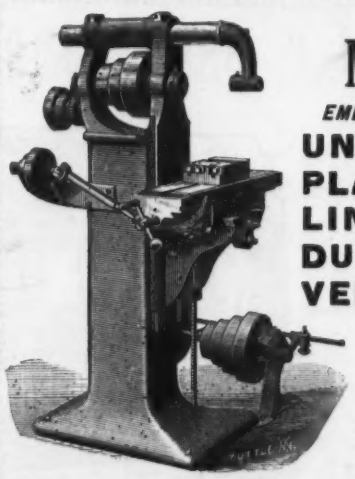

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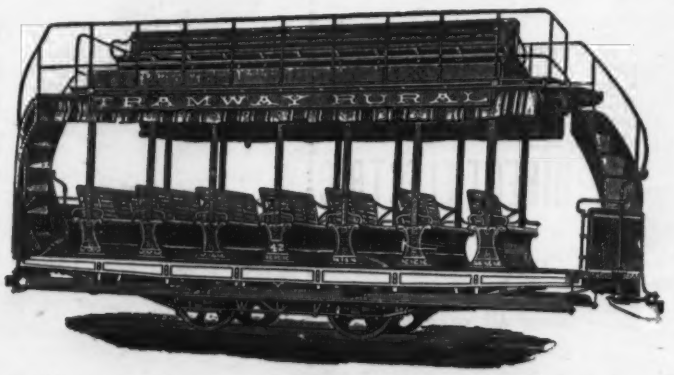

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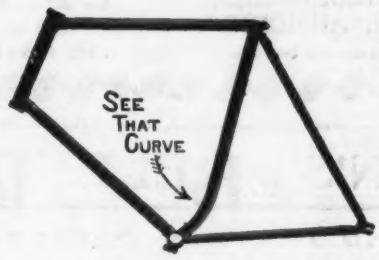

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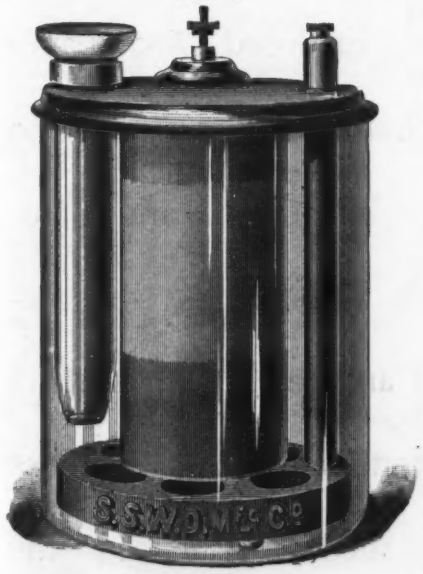

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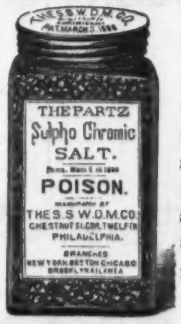

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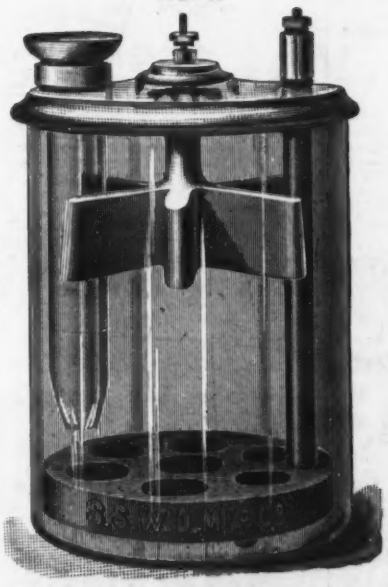

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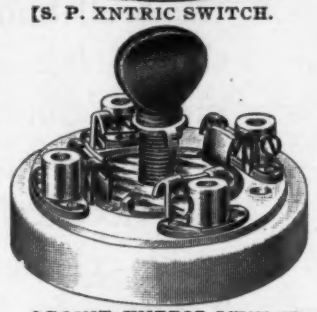
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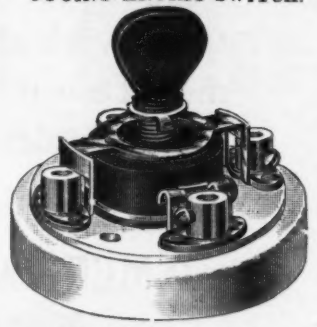
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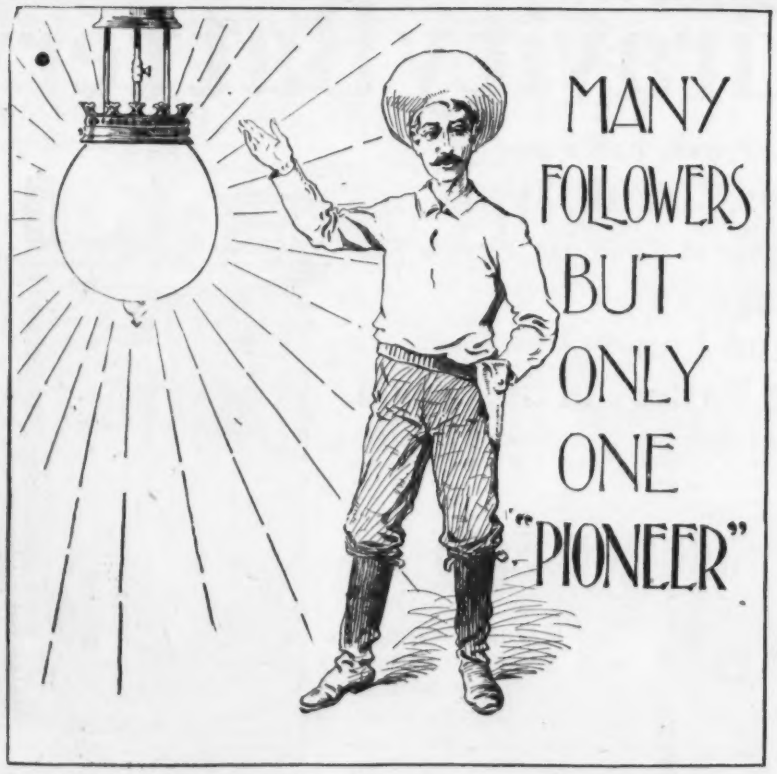

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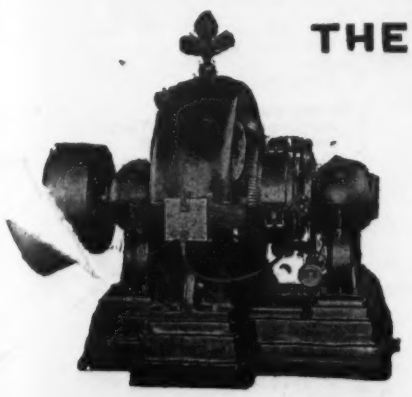

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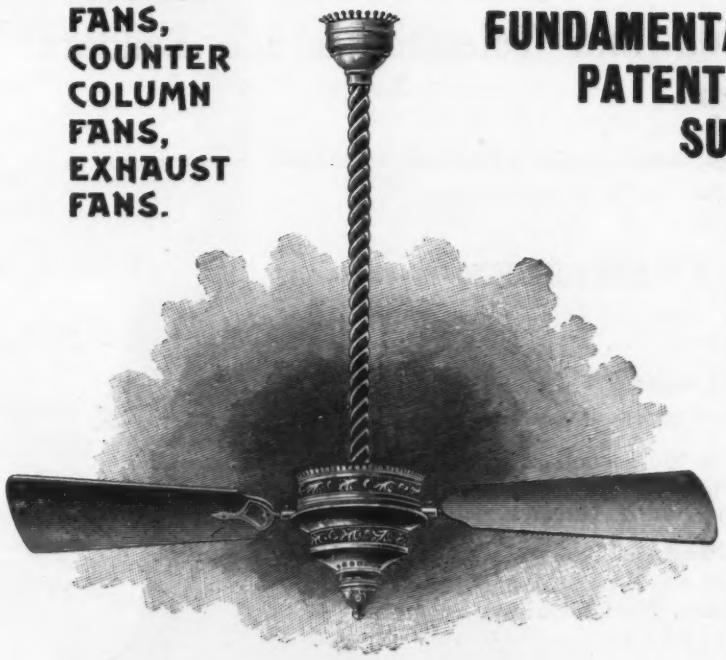

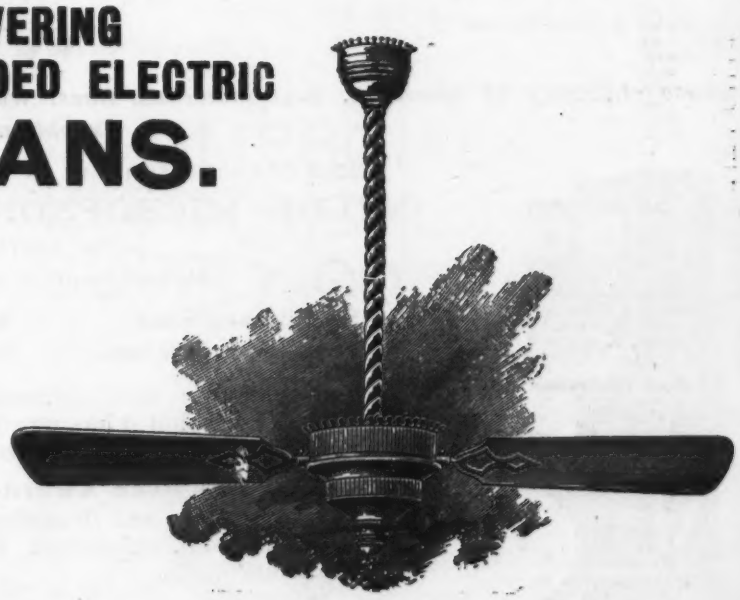

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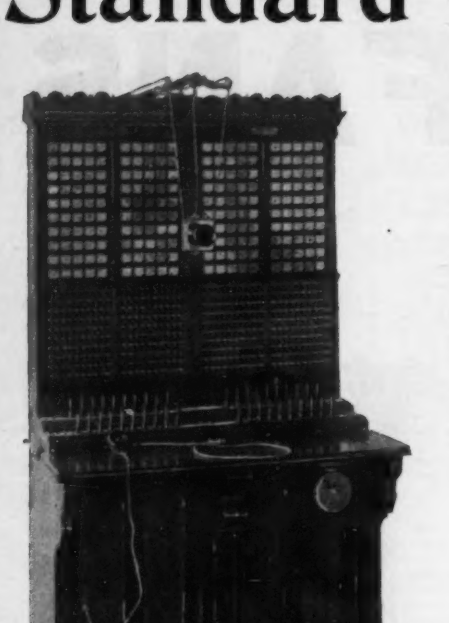

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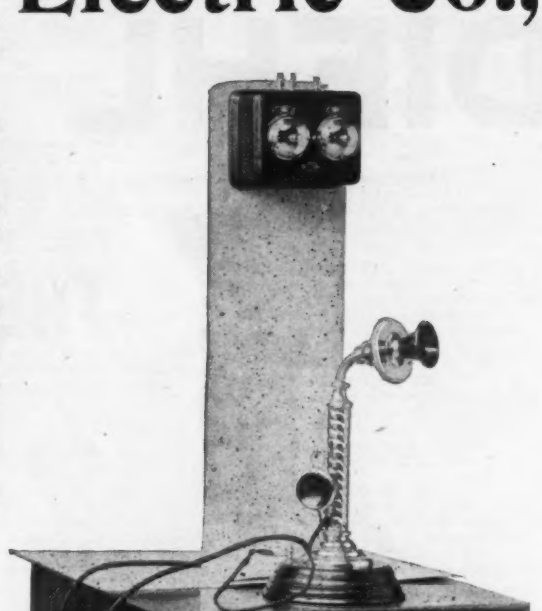

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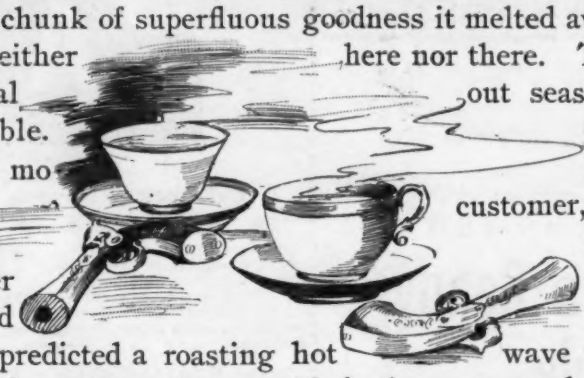
THERE is a decided coolness between us and the weather bureau. We may not be any better than we ought to be. If we ever had a chunk of superfluous goodness it melted away faster than a hundred-pound cake of patent ice, but that is neither here nor there. The vindictive spitefulness of the old fossil who is supposed to deal out seasonable weather from the Auditorium tower, is unaccountable. Just because we happened to have several hundred Lundell motors in stock ready to ship at the first intimation from a good customer, this egotistical limb of the government nervously combs his sapient whiskers and jerks out the cold-stop of his weather machine. We more than suspect that the animus of his frigid humor lies in the fact that on several occasions when he has predicted a roasting hot wave we have annulled its effect by carefully distributing Lundell Fans where they would do the most good. We believe that we know our duty to this community, and we intend to perform it faithfully, even if obliged to ship a few fans as late as next October.



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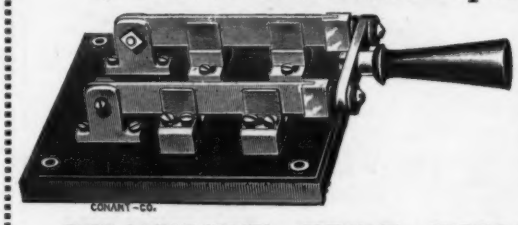

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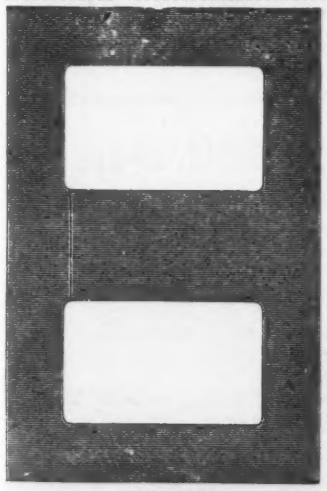

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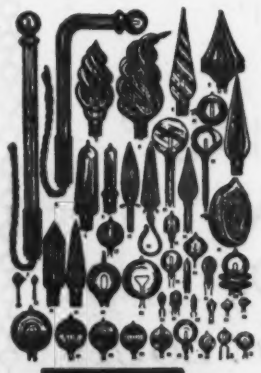

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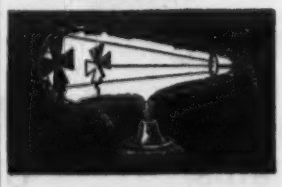
16 c.p., 100 to 118 volts.



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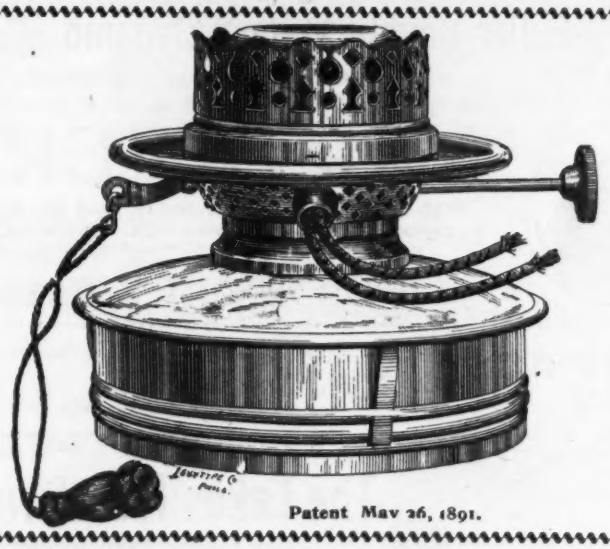

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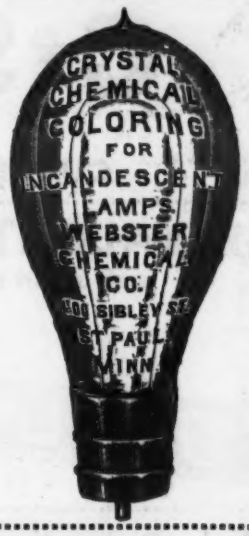

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May 4, 1896.

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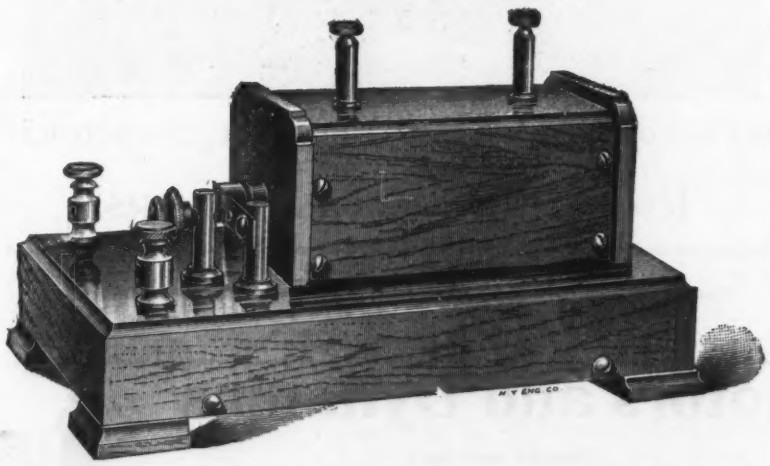

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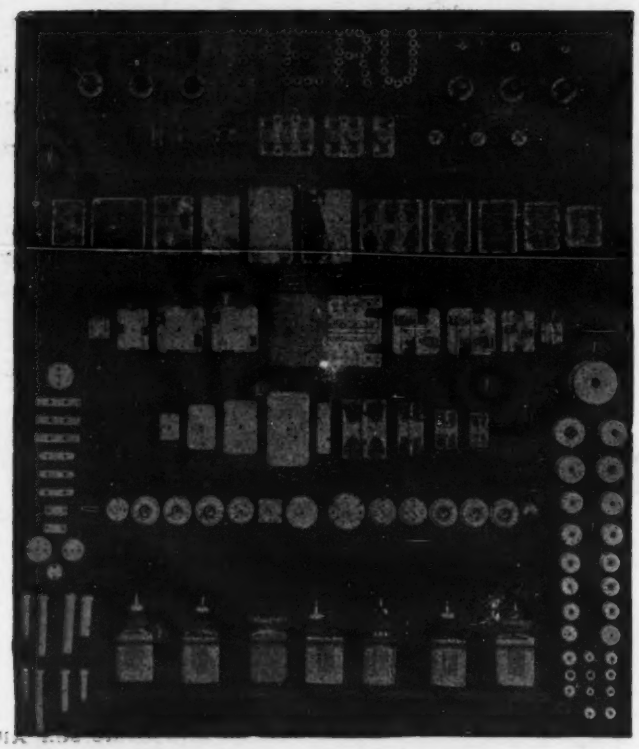

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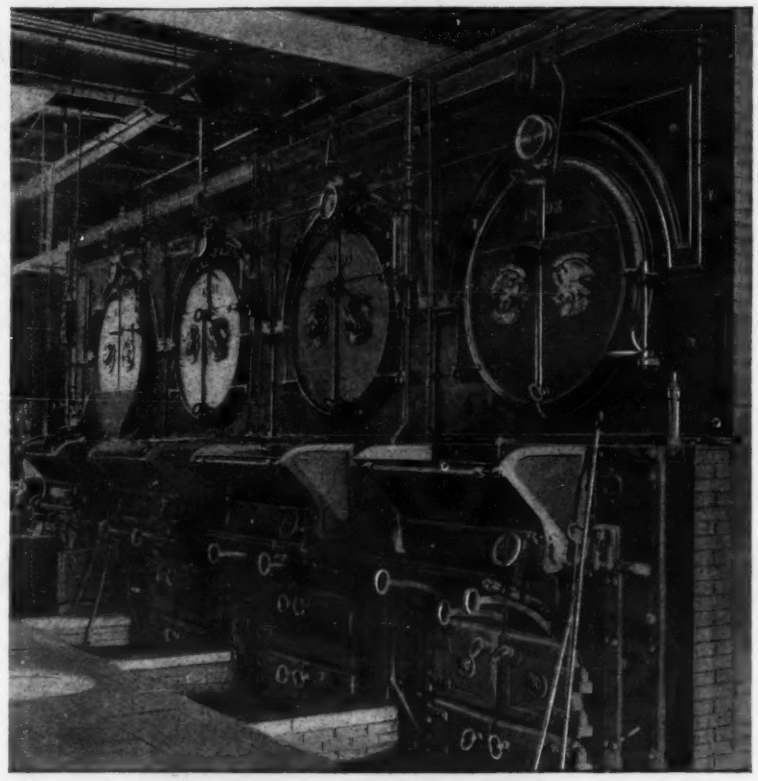

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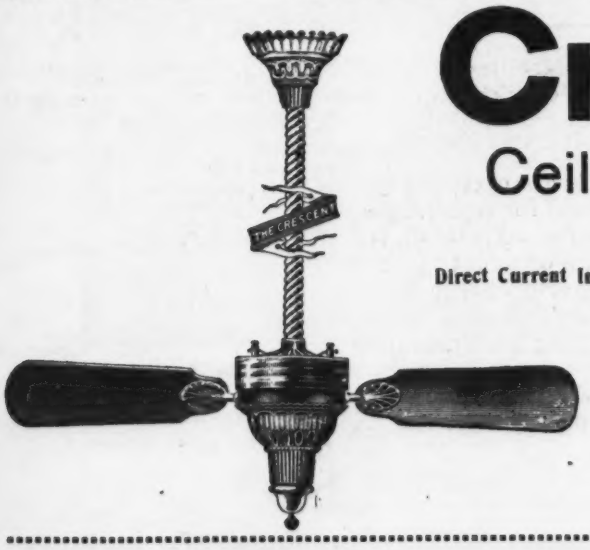

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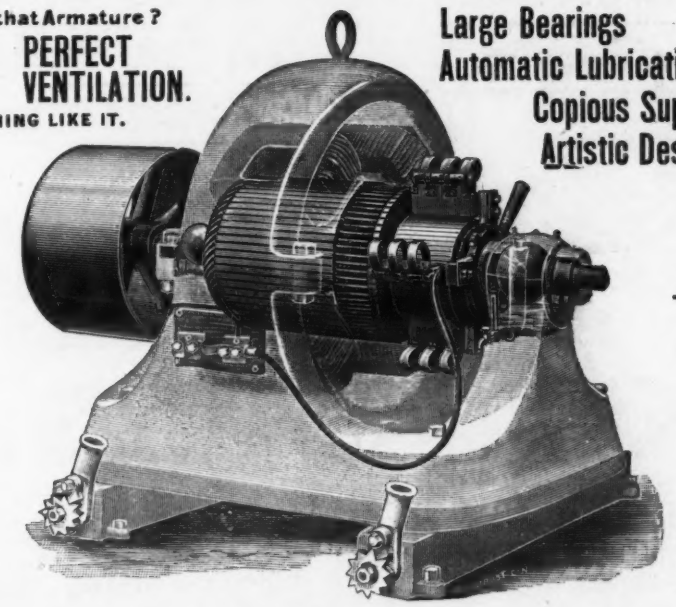

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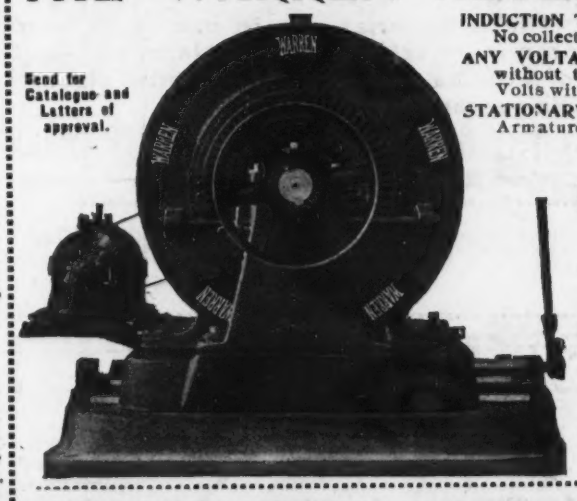

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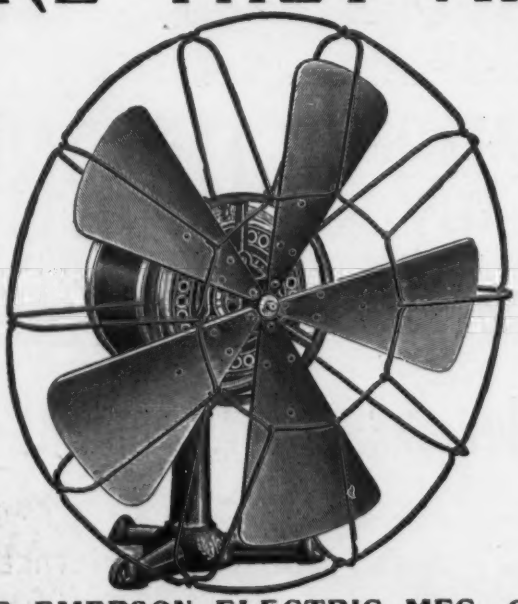

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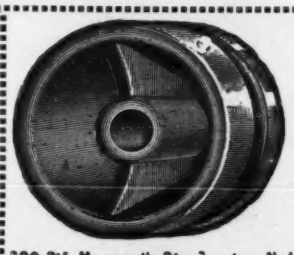

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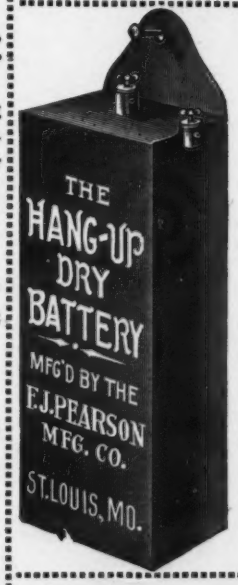

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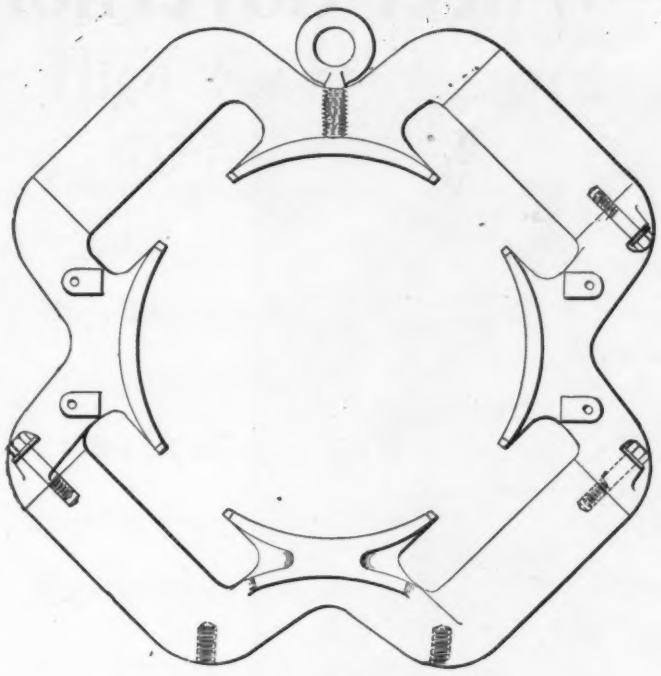

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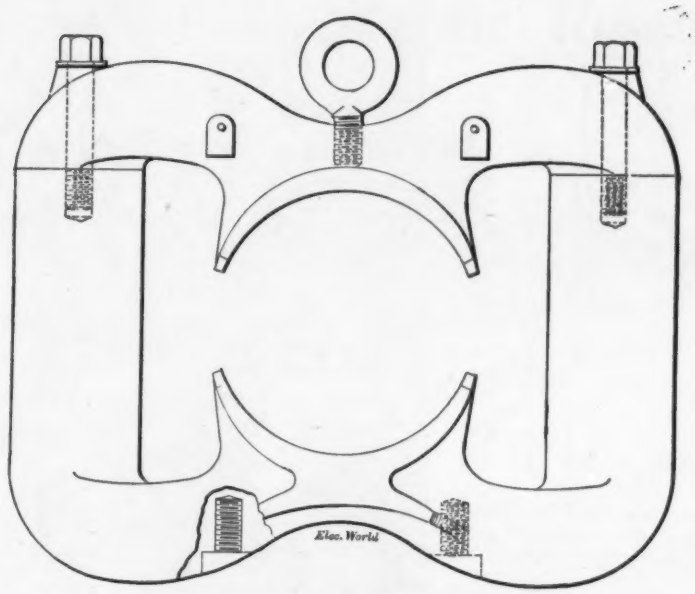

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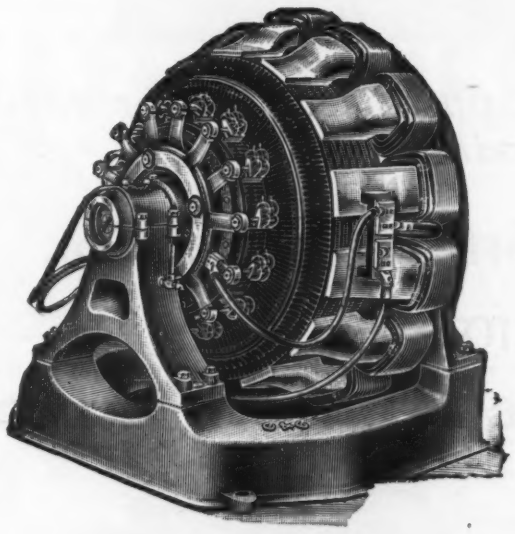

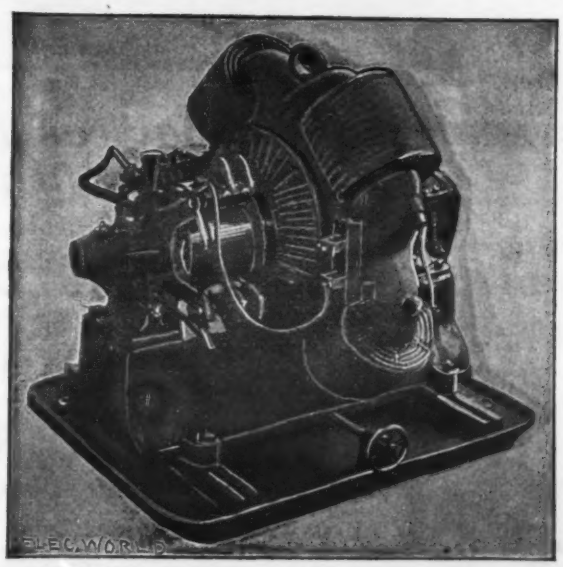

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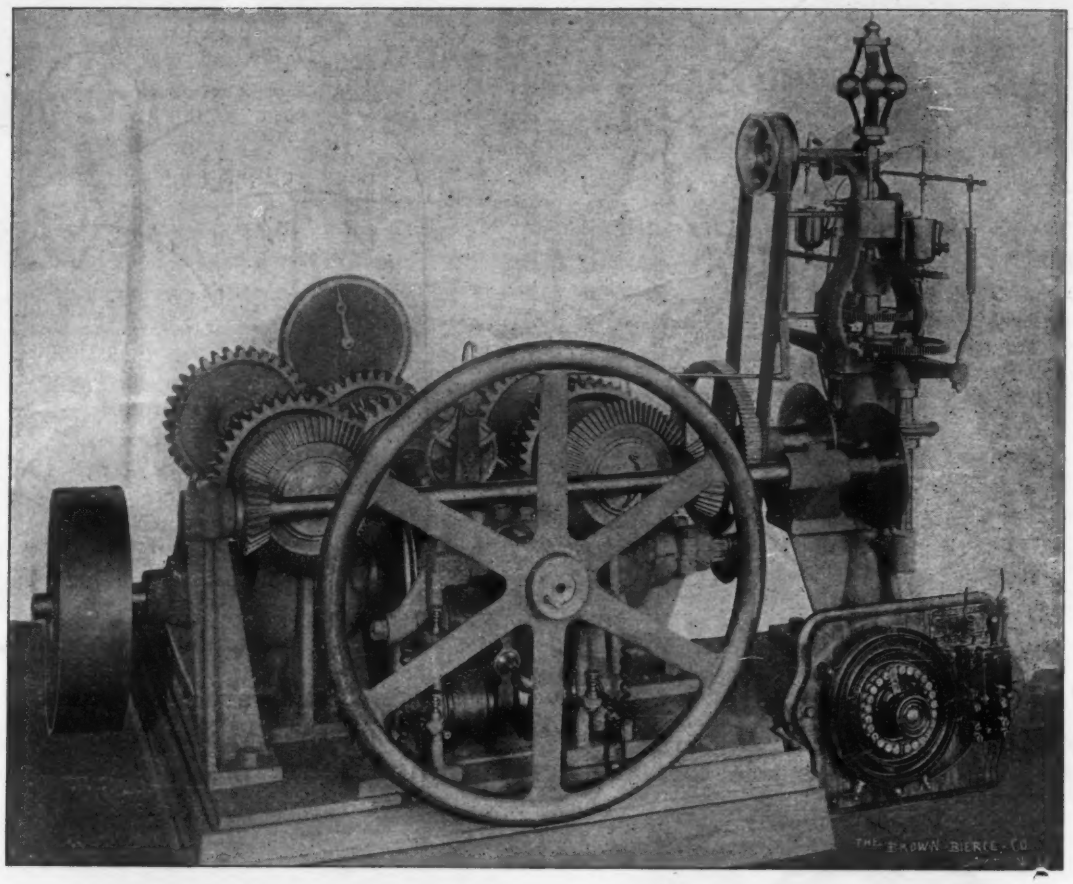

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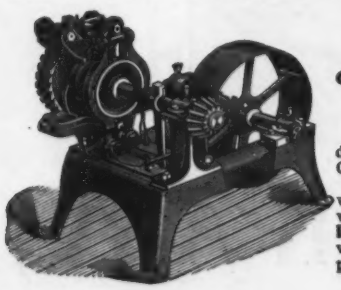

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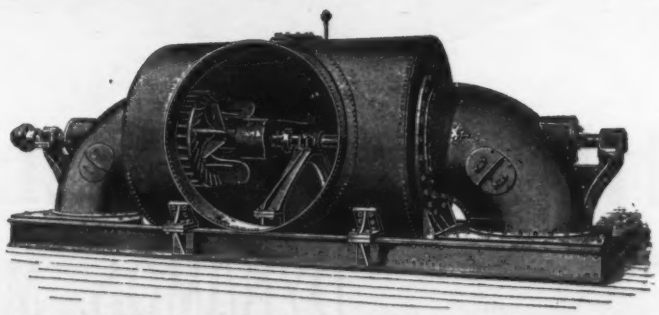

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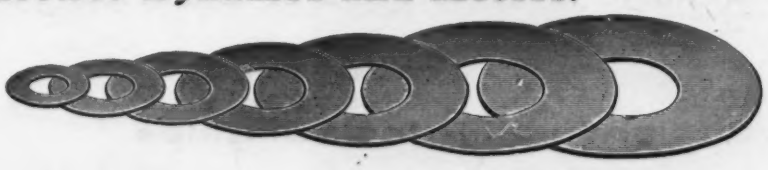

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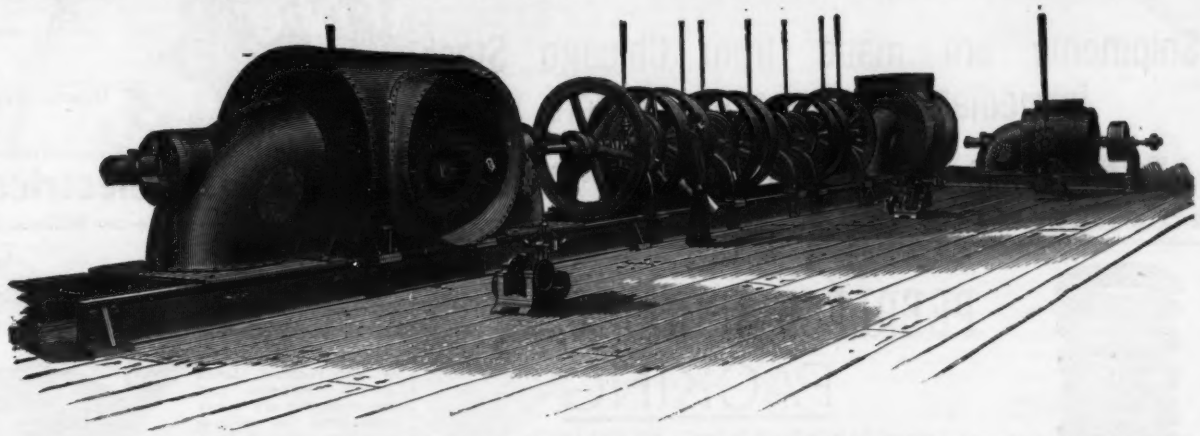

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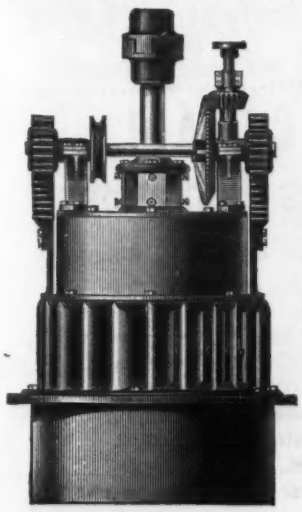

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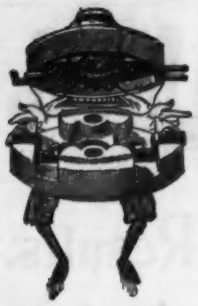

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Our portable instruments are recognized as standards throughout the civilized world.

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The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing because it always gives perfect satisfaction.

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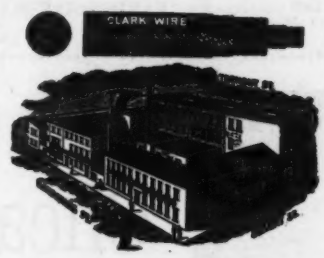

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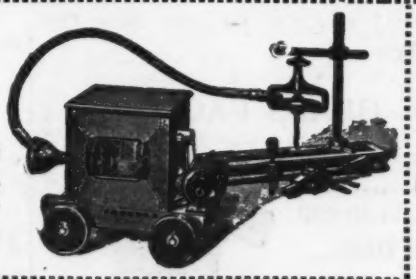
Flexible Shafts for all Purposes
Portable Drilling, Tapping and Reaming Machines, driven either by Electricity or Rope Transmission. Write for catalogue, price list and discounts.



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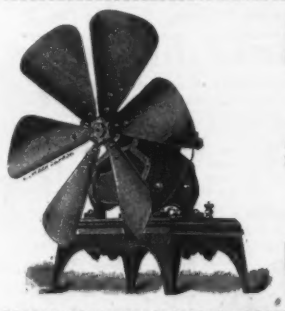

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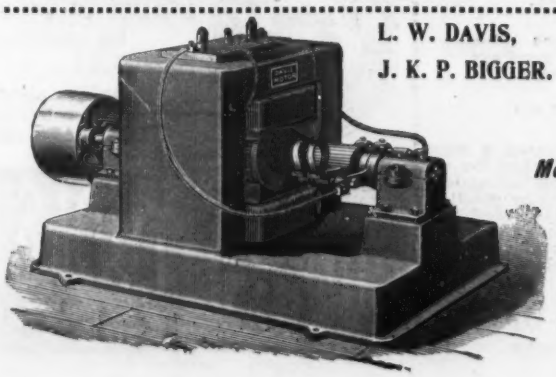

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WANTED—A position where I can learn more and rise higher. Am at present superintendent of lighting plant; am a graduate of Cornell University; well up in the management of boilers, engines and dynamos; know the value and use of the indicator, watt and voltmeter, and coal and water scales; can give A1 references. Open for engagement after July 15th. No small concerns need answer. Address "Ambitious," care The Electrical World, 253 Broadway, New York.

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An electrical engineer, having excellent experience installing and operating steam and electric lighting and power apparatus, desires to act as New England agent for a line of engines and dynamos. Commission and small salary for six months to cover office and traveling expenses. Address "Boston," care The Electrical World, New York.

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From 1 to 250 H. P.

Send for prices. Eighteen years' practical experience armature winding. Established 1890.

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500 volt Generator, either M.P. 100 or Westinghouse 150 h. p., with instruments; state condition, length of service and lowest cash price; must be guaranteed to be in A1 condition.

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An all-round practical electric light man, of good standing, desires to lease an electric light plant in a town of from 5000 to 10,000 inhabitants; prefers one not on a paying basis. Address, giving full particulars, "S.," care The Electrical World, New York.

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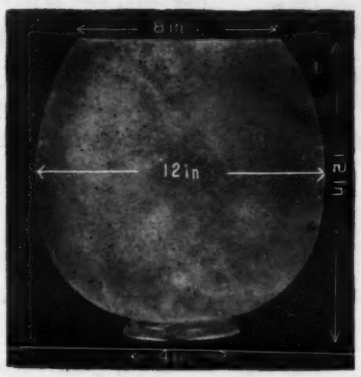

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During the MONTH OF JUNE ONLY, we sell 12x12x8x5 (or any smaller size) Clear Arc Globes at **3 Dozen for $10., Cash with order,** f. o. b. Pittsburgh, no charge for packing. Opal, 3 Dozen for $11. Finest Globes made. Packed in boxes which have less weight, less freight and less breakage than old style casks.

We run all summer, but above prices are for **June only, Cash with order.**

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WANTED.

A 250 or 300-light alternator in exchange for transformers.

Address "B.," Care The Electrical World, N. Y.

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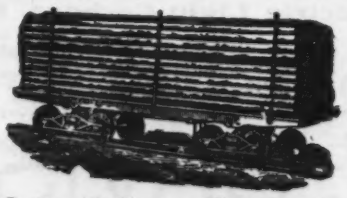

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Electric Lighting Contract

CITY OF ORANGE, N. J.

NOTICE TO CONTRACTORS.—Sealed proposals, to be endorsed "Proposals for Street Lighting, City of Orange," for lighting the streets of the said city by electricity, will be received by the Committee on Street Lighting, at the Council Chamber, Canfield Street Engine House, on Monday, the sixth day of July next, at 8 o'clock p. m.

The said bids will be publicly opened in the presence of the bidders who may choose to attend.

Specifications may be seen by applying to the City Engineer, Orange National Bank Building, Orange, N. J.

ALPHEUS STRUBLE, City Clerk.

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An English electrical company incorporated in 1883 (under Acts of Parliament, 1862 to 1880), has opened a department in its London office for the commercial development of European patents relating to

ELECTRICAL INVENTIONS.

Inventors wishing to propose business of this kind are requested to address, in first instance, "Company," care Messrs. Campbell, Solicitors, 17 Warwick Street, Regent Street, London, W.

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Machinery for the Making of Electric Cables and Insulated Wires.

Cabling, Armoring, Stranding, Taping, Yarn and Compound Serving, Rubber, Silk and Cotton Covering. Hemp, Rope and Cordage Machines. Wire Rope Machines. Plans and Estimates.

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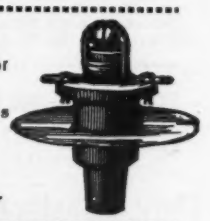
Electric Lava Gas Tip for Multiple Lighting.



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Sold outright, no rent or royalty. Adapted to city, country or village, any distance, complete and connected when shipped. Anyone can put up and operate. Lasts a lifetime. Warranted. Electro Medical Batteries.—Family or physician use. Complete in case. Invaluable for Rheumatism and all Nervous troubles. Fine instruments. Great sellers. Pure Aluminum Specialties and Castings.—Signs, sign letters, figures for stores, offices, shops, hotels, houses, street names, house numbers, elegant door and name plates, mail boxes, &c. Greatest sellers on earth. Agents make $5 to $25 per day. Write for catalogue and wholesale prices. World Mfg. Co., (E) Columbus, O.

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Milwaukee Beer .... is famous

Pabst has made it so.

Been Sick?

Get well by using Pabst Malt Extract "The "Best" Tonic

PRESSES, DIES AND OTHER SHEET-METAL TOOLS

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FOR SALE.

Arc Dynamos.

1 M. 12, 45 Light, 1200 C. P., T.-H., (new armature).....$450 each.
2 50 Light 2000 C. P., Schuyler.... 400 "
2 35 Light 2000 C. P., Schuyler.... 350 "
1 50 Light 2000 C. P., American.... 600 "
1 50 Light 1200 C. P., American (new)..... 700 "
1 35 Light 2000 C. P., American... 450 "
1 25 Light 2000 C. P., American... 375 "
1 10 Light 2000 C. P., American... 200 "
2 45 Light 1200 C. P., Excelsior... 550 "
6 30 Light 2000 C. P., Excelsior... 400 "
2 20 Light 2000 C. P., Ball..... 275 "
1 35 Light 2000 C. P., Ball..... 300 "

Direct Current Dynamos.

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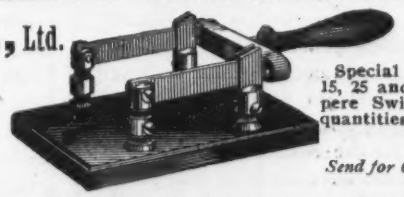

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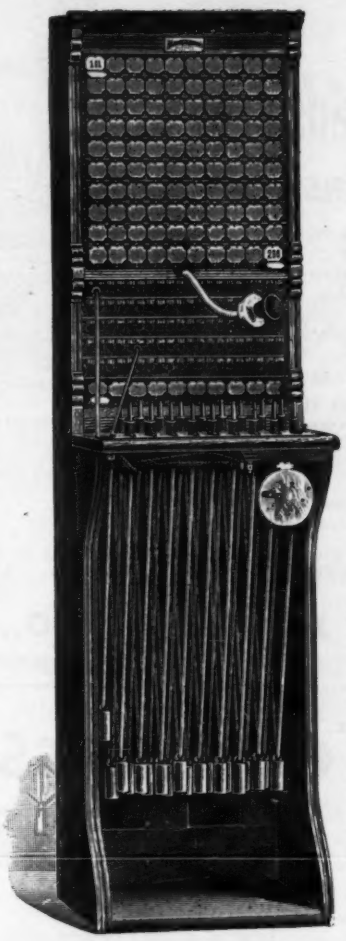

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CONTENTS.

Historical Sketch of Electricity from 600 B.C. to 1882 A.D.—Facts and Figures About the Speaking Telephone.—How to Build a Short Telegraph or Telephone Line.—The Earth and Telephonic Systems of Communication.—The Magneto-telephone: How Made and How it Should be Handled.—The Blake Transmitter.—Disturbances Experienced on Telephone Lines.—The Telephone Switch-board.—The Magneto-bell.—Telephone Transmitter Batteries.—Lightning: How to Prevent or Reduce Troubles Arising Therefrom.—The Telephone Inspector.—The Telephone Inspector: His Daily Work.—The Inspector on Detective Duty.—The Daily Routine of the Telephone Inspector.—Individual Calls for Telephone Lines.—Telephone Wires *versus* Electric-light Wires.—Electric-bell Construction, Part I.—Electric-bell Construction, Part II.—Housetop Lines, Pole Lines, and Aërial Cables.—Anticipations of Great Discoveries and Inventions.

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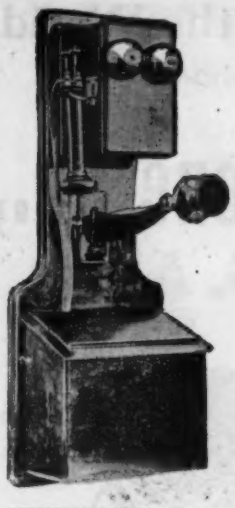

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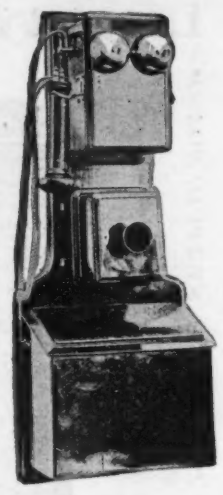

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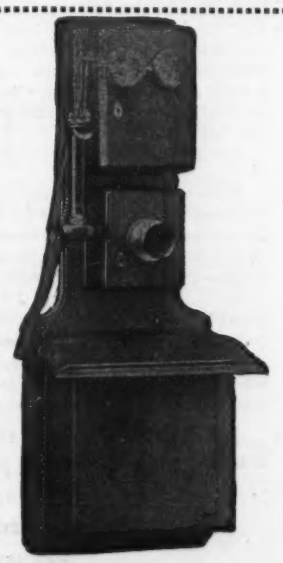

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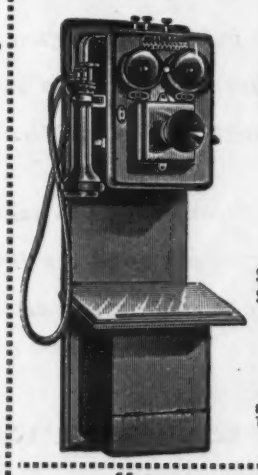

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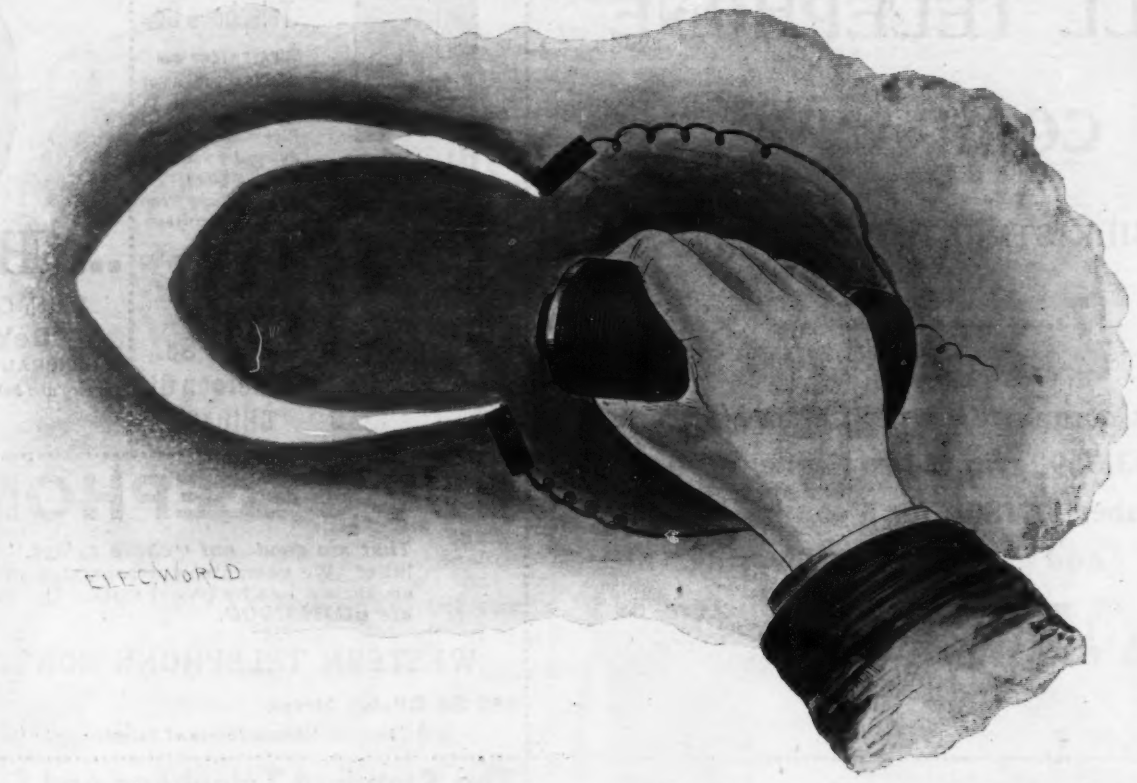
with a magnet, a number of things are necessary.



The arc must carry considerable current before the magnet can repel it.

The arc must have some length, otherwise it will be too stable to rupture.

In other words, it must be powerful enough to do considerable damage to contacts before the magnet will act.

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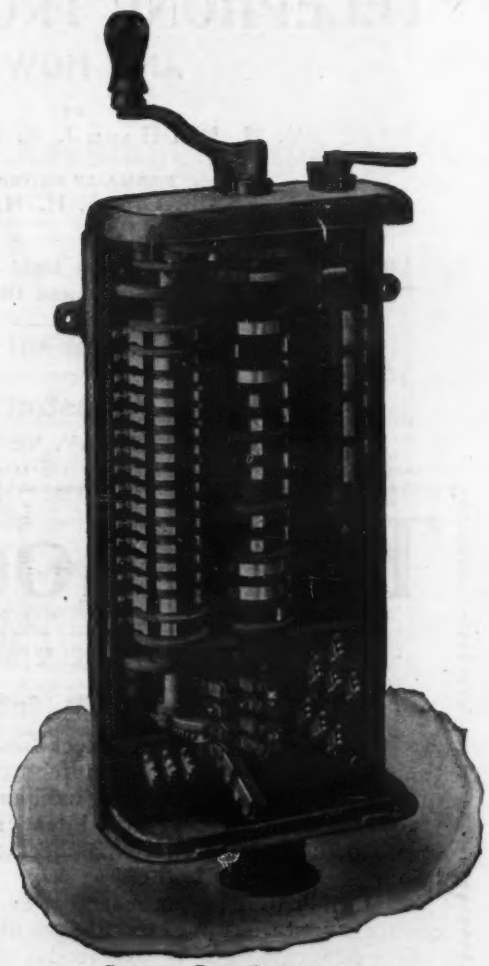

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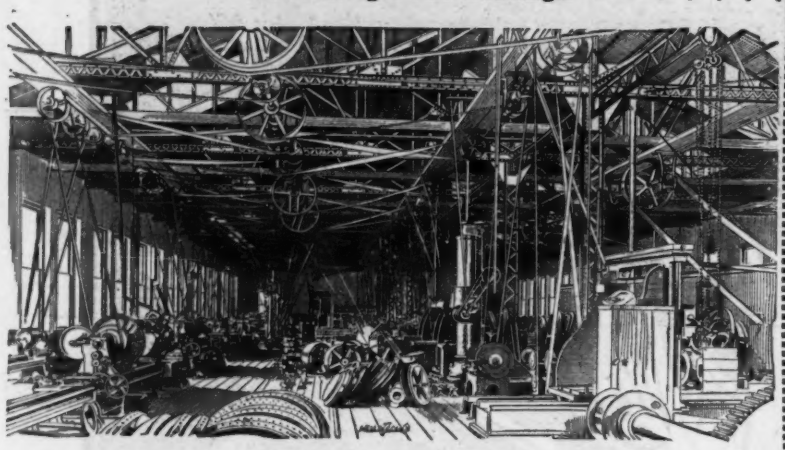

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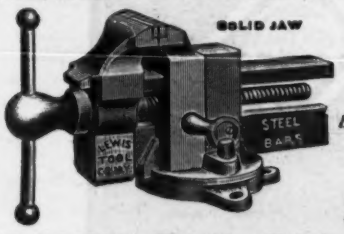

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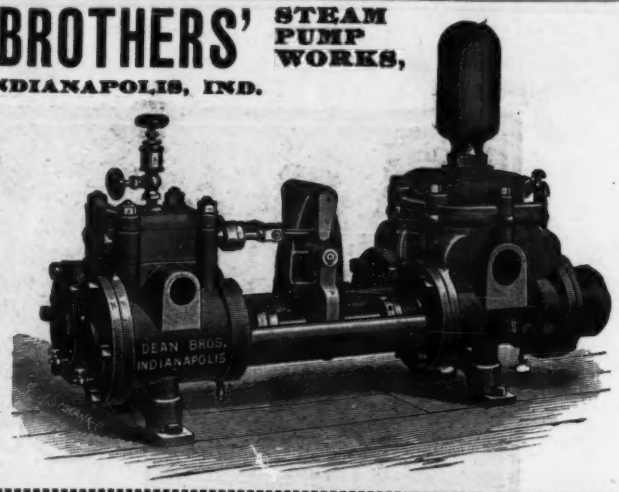

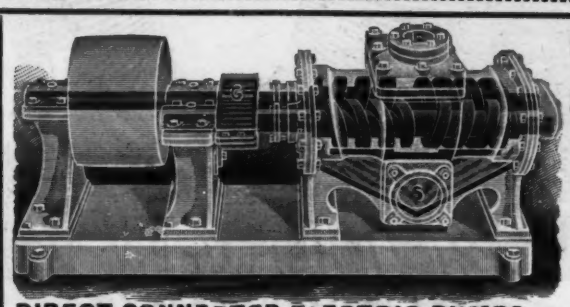

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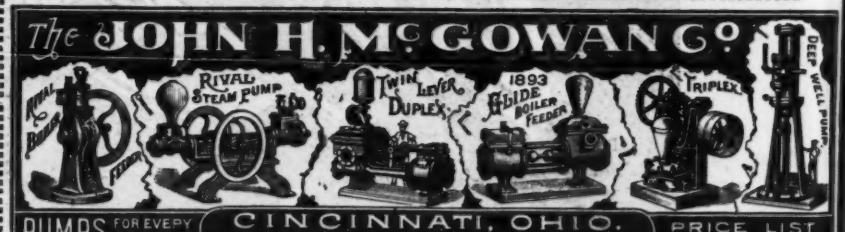

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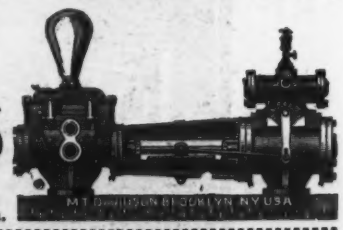

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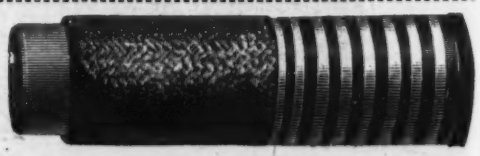

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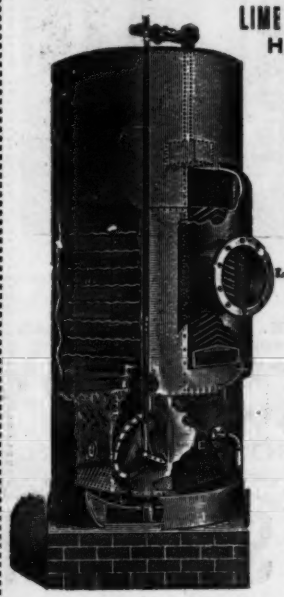

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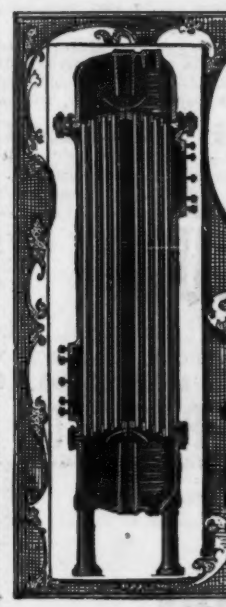

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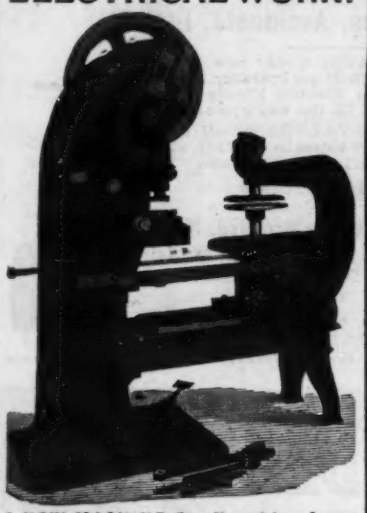

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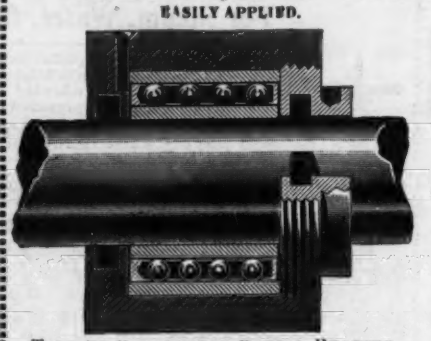

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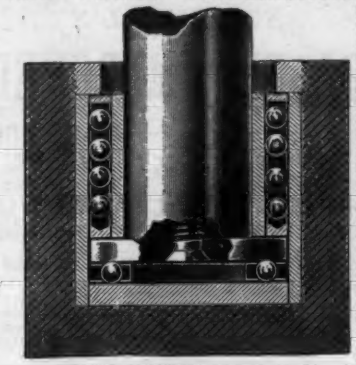

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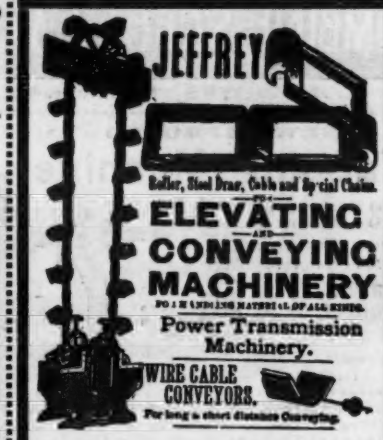
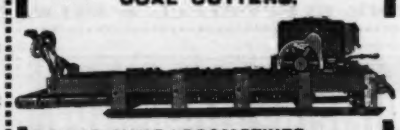


COAL CUTTERS.



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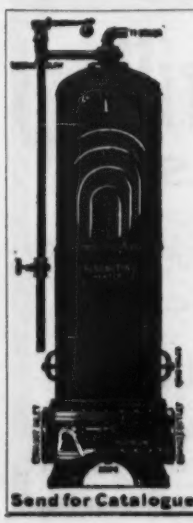

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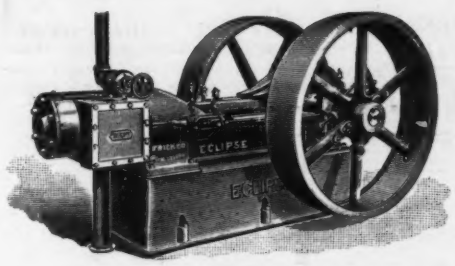

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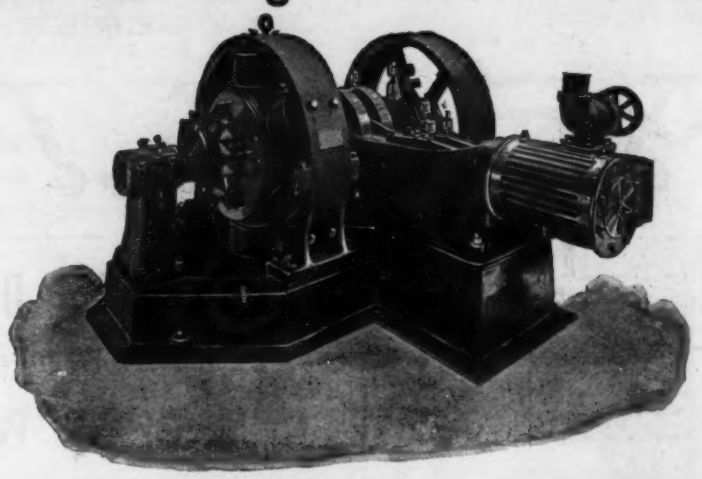

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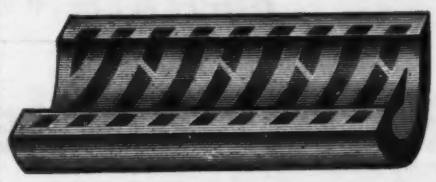

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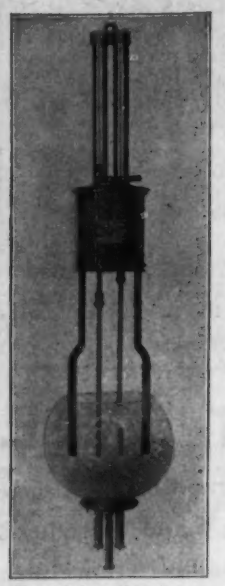
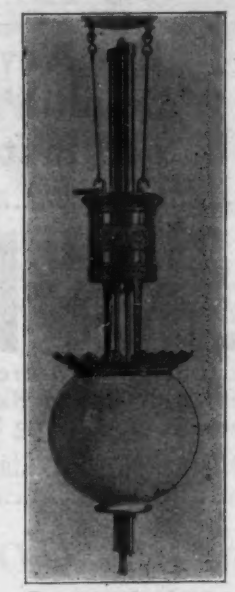


Double Carbon Plain Lamp.



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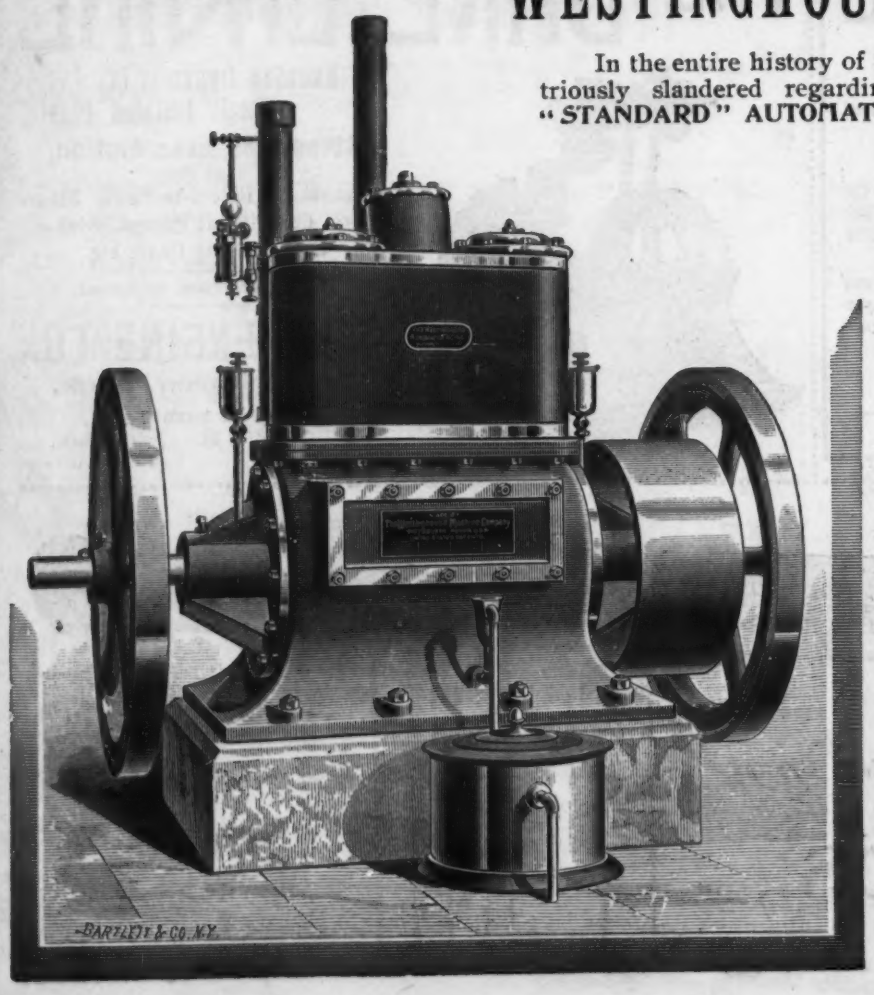

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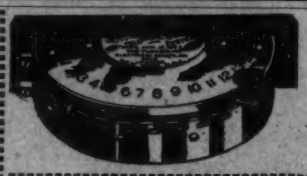

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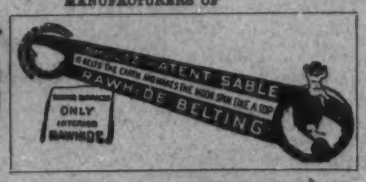

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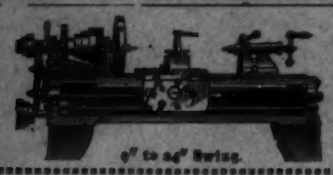

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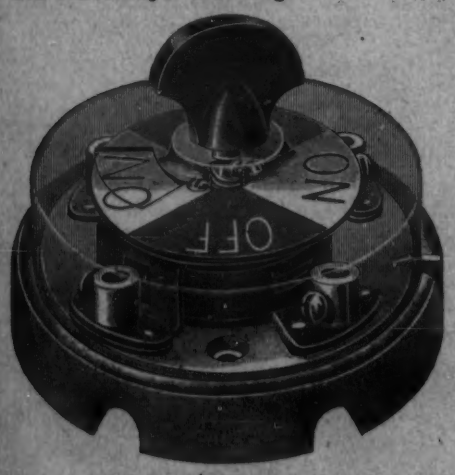

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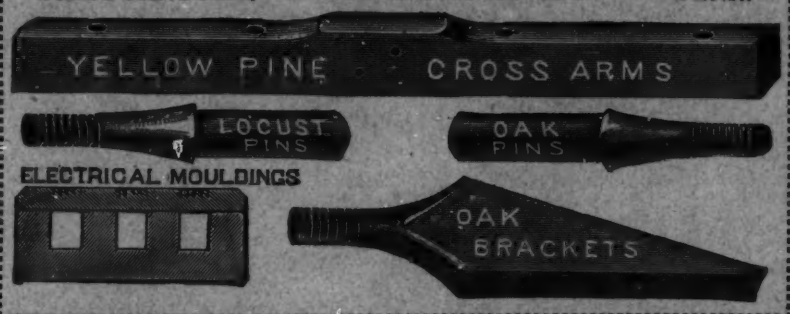

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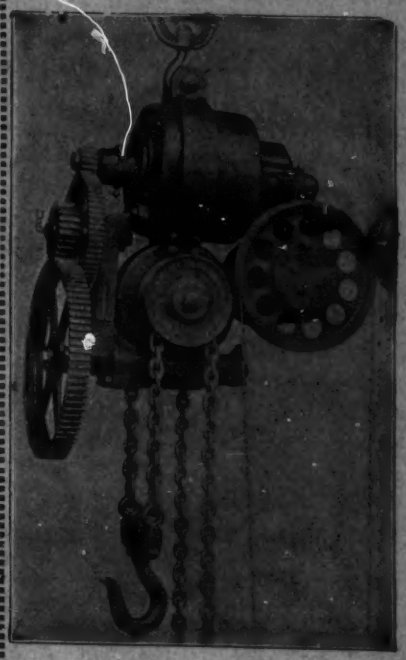

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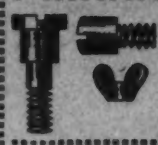

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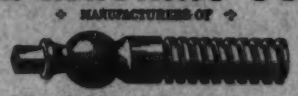

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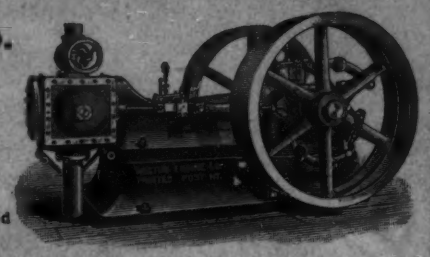

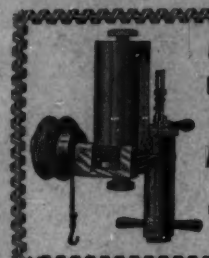

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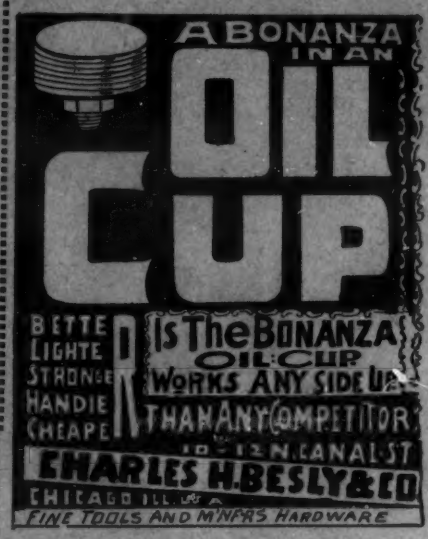
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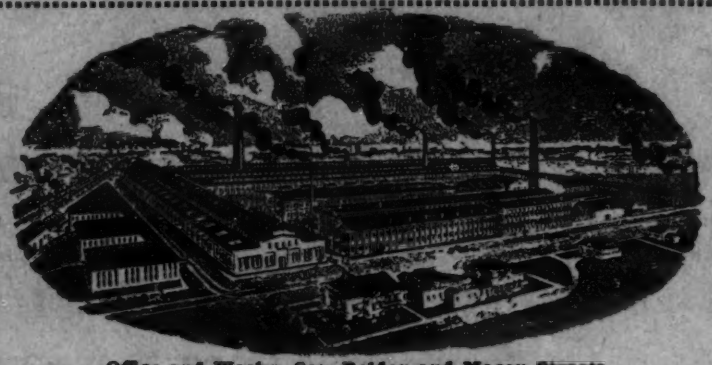

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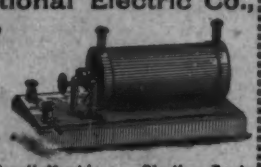

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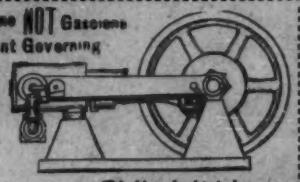

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